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Item 3(b) of the provisional agenda
Accelerating and deepening the transition to sustainable energy systems: Pathways to sustainable energy: status update

Pathways to Sustainable Energy- Status Report

Note by the secretariat

I. Introduction

1. During previous sessions of the Committee on Sustainable Energy (the Committee), member States endorsed the project "Pathways to Sustainable Energy" and requested the secretariat to take steps towards its implementation (ECE/ENERGY/99, paras. 79–81, and ECE/ENERGY/2016/7[1]). At its twenty-sixth session, the Committee requested a report on progress and preliminary results for presentation at its twenty-seventh session (ECE/ENERGY/113, para. 36).

2 The project concept note (ECE/ENERGY/2016/7) presented at the twenty-fifth session of the Committee on 28–30 September 2016 and a white paper (CSE-24/2015/INF.7) prepared for the twenty-fourth session of the Committee on 19–21 November 2015, provide further information about the background and the project proposal.

3. Project implementation is ongoing with a focus on the development of policy options and adaptive policy pathways, increasing stakeholder engagement and the preparation of future policy dialogues. This document seeks to inform the Committee on progress made since October 2016. It also provides a timeline for the major milestones (see the annex of this document).

[1] Further information can be found in a white paper prepared for the twenty-fourth session of the Committee (CSE-24/2015/INF.7) on 19–21 November 2015. http://www.unece.org/fileadmin/DAM/energy/se/pdfs/comm24/rd/CSE-24_2015_INF.7.pdf.

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4. The Committee will be asked to comment on achievements, provide input and recommendations for the implementation of the project, and endorse future activities (see Chapter VIII).

II. Background

5. Energy underpins most of the goals and targets of the 2030 Agenda on Sustainable Development (2030 Agenda), and the energy sector plays a critical role in finding solutions for both sustainable development and climate change mitigation. Since the universal agreement on the seventeen Sustainable Development Goals (SDGs) including the goal on sustainable energy "SDG 7" in 2015, countries have commenced with the implementation of the 2030 Agenda, however, at this stage, there is a gap between the agreed energy and climate targets and the strategies and systems that are being put in place today. Accelerated and more ambitious strategies and policies will be needed to fill the persistent gaps to achieve the 2030 Agenda, and in particular, energy will need to play an increasing role across various SDGs.

6. One conundrum is particularly relevant for the region of the United Nations Economic Commission for Europe (ECE), namely that there is not yet a universally accepted definition of "sustainable energy", nor that countries have agreed on a pathway to achieve energy for sustainable development. Therefore, for the ECE region, there is now an important opportunity to explore the implications of different sustainable energy pathways and to work with member States on policies and measures for attaining the 2030 Agenda.

7. Recognising this opportunity, at its twenty-third session, the Committee agreed on a project to enhance the understanding of sustainable energy policy drivers in ECE member States, based on a policy dialogue and robust stakeholder consultations and including awareness-raising of different outcomes that could emerge over time.

8. Following the initiation of the project, stakeholder engagement workshops were organized between 2015 and 2016 to discuss key uncertainties and influencing factors for the future of sustainable energy. This expert based scenario building approach led to the formulation of four distinct equally plausible futures, which are referred to as sustainable energy storylines. The storylines provide the qualitative backdrop and larger context for the scenario analysis.

9. The project "Pathways to Sustainable Energy" presented in this document combines the modelling of sustainable energy scenarios with the development of a monitoring and early-warning system concept that can assess progress in achieving sustainable energy targets. The scientific assessment could inform a policy-dialogue among ECE member States and ECE sub-regions to explore how targets can be achieved from different starting points and national priorities. The ultimate outcome of the project is the development of new strategic orientations, options and national actions to ensure the attainment of sustainable energy in the ECE region.

III. Objective of the project "Pathways to Sustainable Energy"

10. The project's goal is to strengthen the knowledge and capacities of countries to develop, implement and track national sustainable energy policies aligned with international agreements. On a higher level, it aims to contribute to climate change mitigation and sustainable development. To achieve this goal, the project aims to achieve three milestones:

(a) development of sustainable energy policy and technology options towards 2050 by means of modelling and other tools;

(b) development of an early-warning system if achievement of sustainable energy objectives is not on track; and

(c) facilitation of energy expert and policy exchange formats.

IV. The status of the project: October 2016 to June 2018

11. Three institutions will support the development of the modelling framework and scenario outputs: i) Fraunhofer Gesellschaft (Fraunhofer; represented by the Institute for Environment, Safety and Energy Technology – UMSICHT and the Institute for Systems and Innovation Research - ISI); ii) the International Institute for Applied System Analysis (IIASA); and iii) the Pacific North West National Laboratory (PNNL). The three institutions have been chosen based on their academic merits and their extensive experience and international recognition in the field of sustainable energy research. IIASA and PNNL will provide the modelling of the sustainable energy scenarios and the testing of policy options within them. Fraunhofer will provide the assessment of technology options to be used as input parameters within the scenarios.

12. The analysis of scenarios will be undertaken within both models to increase accuracy of modelling results and transparency in scenario formation. This will further be supported by Fraunhofer's analytical work comparing technology input parameters of both models with literature and with each other. Recommendations for adaptation of input assumptions will be put forward where necessary. Both models provide global results, the ECE perspective, and sub-regional results. The analysis of sub-region will in some cases be divided, in particular with IIASA providing more detailed analysis on the Eastern part of the ECE region.

13. Implementation of all activities across the three project components is ongoing. In first instance, the team focused on the development of the key parameters that will shape the analysis of scenario outcomes and strategic options for achieving sustainable energy and preparing the supporting quantitative analysis. In terms of scenario modelling, at this stage, the modellers have prepared the "No Policy Scenario", the "Current Policies including NDCs" and a "2-degree Celsius" scenario, (see details in Chapter IV.A). The Committee will be presented with intermediate results at its twenty-seventh session and will be invited to engage in a policy dialogue to shape further outcomes of the project.

14. A summary of the achievements for each of the three expected outputs is provided below. Informal document CSE-27/2018/INF.8 provides a detailed assessment of the implementation of each activity as outlined in the project concept note. A glossary of key vocabulary/terminology used for the project has been published online.[2] Further iterations of the document are likely and inputs are encouraged, as it will further narrow the definition of what is sustainable energy.

15. All activities have been overseen by the Bureau and a Technical Advisory Group (see details on the project governance in Annex Chapter I-B), with opportunities to provide input through online consultations and through the quarterly Bureau meetings.

[2] The glossary can be downloaded online: https://www.unece.org/energy/welcome/areas-of-work/pathways-to-sustainable-energy/resources.html

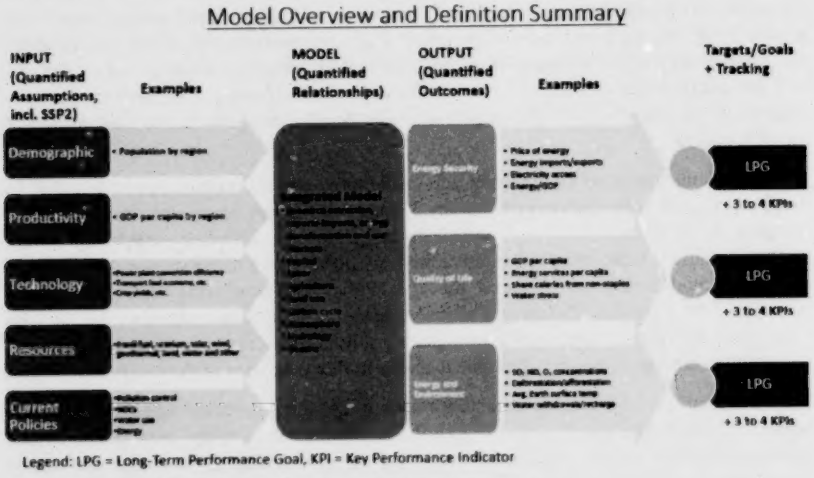
A. Modelling of sustainable energy scenarios

16. To support achievement of deliverable (i), existing energy models from IIASA and PNNL will be used to illustrate sustainable energy scenarios and pathways to 2050. IIASA's work is based on *the Model for Energy Supply Strategy Alternatives and their General Environmental Impact* (MESSAGE), while PNNL uses the Global Change Assessment Model (GCAM). Both models provide a framework for medium- to long-term energy system planning, energy policy analysis, and scenario development while allowing linkages to other sectors.

17. So far, the modelers have undertaken significant work to prepare and link the two models, including the disaggregation of ECE sub-regions and respective data, and the integration of current policies, for example existing energy and climate objectives and targets.

18. For the purpose of the modelling, the ECE region is divided into seven sub-regions. Analysis and presentation of results will be undertaken on sub-regional rather than on country level, with the principle outcomes being transferable to the national level. Modelling regions within MESSAGE include North America (NAM), Western Europe (WEU), Eastern Europe (EEU), Russian Federation, Central Asia, Caucasus and BMU (Belarus, Moldova, and Ukraine).

19. Figure (i) summarizes the modelling approach:



Legend: LPG = Long-Term Performance Goal, KPI = Key Performance Indicator

20. The scenario analyses will comprise three distinct stages:

(a) Base scenario (SSP2). This will act as the "No Policy Scenario";

(b) SSP2 + current policies (including NDCs, energy policies, etc.,). A policy scenario based on NDCs under the Paris Agreement for 2030 (NDCs kept beyond 2030 until 2100) with four cases along the two axes "International Cooperation" and "Innovation: technology, business models". These will act as the "Current Policies incl. NDCs Scenarios";

(c) Base + current policies + adaptive policy pathways to achieve targets (Key Performance Indicators (KPIs) and Long-Term Performance Goals (LPGs) including 2°C). These will be called "Sustainable Energy Policy Scenarios". In total, the modelers will develop 4-5 policy scenarios.

21. During the kick-off workshop of the modeler team in May 2017, in order to derive the baseline input assumptions, the modelers decided to build upon existing scenario work by using the Socio-Economic Pathways (SSPs) as base scenario. The advantage of using the SSPs is that they have been developed through various iterations by an international research community, including IIASA and PNNL, with the objective to provide five narratives describing alternative socio-economic developments and plausible major global developments. SSPs are used to analyse the feedbacks between climate change and socioeconomic factors and to develop scenarios for use by the research community. The SSPs include qualitative narratives and quantitative elements.[3]

22. To develop the project scenarios, basic socio-economic assumptions from SSP2 and respective datasets will be used. SSP2 will function as the base scenario ("No Policy Scenario") for each scenario developed under the Pathways project as it describes a "middle of the road" scenario. The development of the subsequent policy scenarios is linked to storylines that were developed through a participative approach with energy experts in 2015 and 2016.

23. The project further includes an activity that aims to assess in how far existing strategies can help to achieve the set energy and climate targets. ECE undertook the first assessment of the status of achievement of the three SDG 7 targets through the report "Global Tracking Framework: ECE Progress in Sustainable Energy".[4] Published in December 2017, the report summarizes the status of progress in achieving SDG7 and also provides an outlook if the progress is on track. The progress tracking initiative relates closely to the Pathways project in particular through the selection of KPIs and the definition of signposts (see Chapter IV-B) which partly represent SDG indicators. In addition to this tracking report, the scenario work will further help understand the gap between current policy-making and targets set by international agreements or on a national basis. The identification and testing of policy options will be used to formulate adaptive sustainable energy policy pathways and develop strategic recommendations that countries can consider in their future policy-making.

24. In order to increase transparency of input parameters used in the models, Fraunhofer prepared a technology survey.[5] Technologies included are: solar photovoltaics, concentrated solar power, wind, hydro, nuclear, coal-fired power plants, gas combustion, and biomass. The technology description highlights the technical description as well as the most common technology variations (e.g. thin film cells versus wafer based silicon cells) and a technological outlook for cost development and technical efficiency. The technology portfolio seeks to provide a general descriptive guide for the power generation technologies deployed in both models GCAM and MESSAGE. It will help compare and illustrate the differences within the set of assumptions regarding the technology assumptions used in both models and further relates the model values to existing literature values.

25. Both models used for the project have a similar cost hierarchy. This means that technologies on the lower or upper end of cost rankings are similar in both models. In the remaining project period for phase 1 until October 2019, Fraunhofer will prepare

[3] See detailed description of SSPs: Riahi K. et al (2017): The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. In: Global Environmental Change 42 (2017) 153–168.

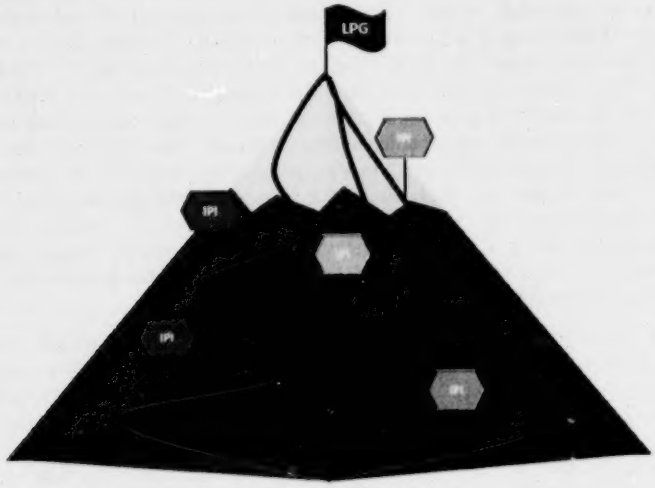
[4] The report can be downloaded online: https://www.unece.org/fileadmin/DAM/energy/images/CSE/publications/Global_Tracking_Framework-_UNECE_Progress_in_Sustainable_Energy.pdf

[5] The summary report „Technology Portfolio: Comparison of Technical Input Parameters from MESSAGE and GCAM" can be downloaded on the project website: https://www.unece.org/fileadmin/DAM/energy/se/pdfs/Pathways_to_SE/Report_Technology_Portfolio_UMSICHT_ISI_FINAL.pdf

technology zoom-ins for carbon capture and storage (CCS), storage, energy efficiency and power to X.[6]

B. Conceptualisation of an early-warning system

26. To support achievement of deliverable (ii), work is under way to define the different aspects of the early-warning system. The purpose of this system is to inform countries if achievement of sustainable energy objectives is not on track, and help identify the national status of moving towards the implementation of the 2030 Agenda and the Paris Agreements. Signposts and selected indicators will allow countries to track if their chosen policy actions prove to be successful, or if course corrections are required to achieve the 2030 Agenda. The early-warning system could further help assess the direction of a global scenario or pathway over time. Figure (ii) visualizes scenario development, highlighting different pathways that will ultimately lead to the same desired result:



Legend: LPG = Long-Term Performance Goal
KPI = Key Performance Indicator
IPI = Interim Performance Indicator (signpost)

27. As no universally agreed definition of sustainable energy exits, the project proposes the following working definition:

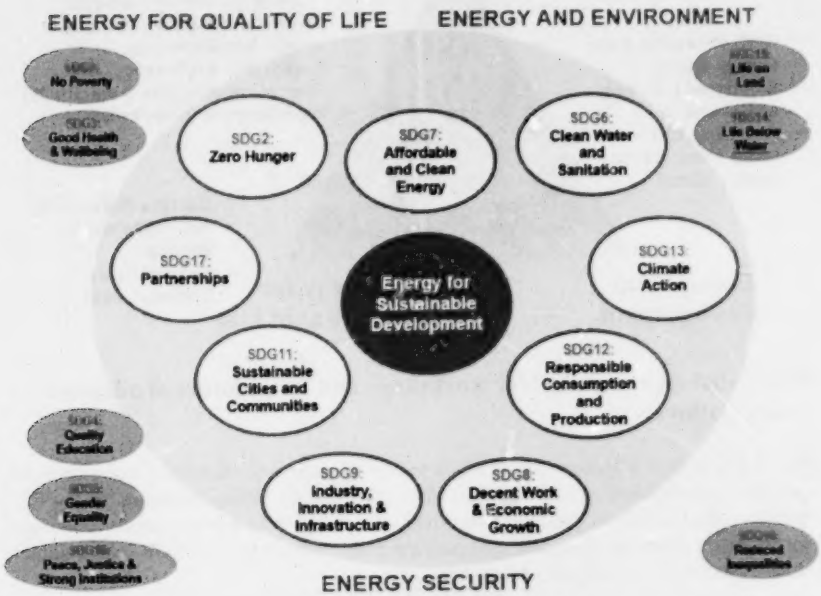
(a) Pillar I "Energy Security": Securing the energy needed for economic development;

(b) Pillar II "Energy for Quality of Life": Provide affordable energy that is available for all at all times;

(c) Pillar III "Energy and Environment": Minimize the impact of energy system on climate, ecosystems and health.

[6] Such as power-to-ammonia, power-to-chemicals, power-to-fuel, power-to-gas, power-to-heat, power-to-hydrogen, power-to-liquid, power-to-methane, power-to-mobility, power-to-power, and power-to-syngas. power to gas, power to hydrogen.

28. Figure (iii) seeks to visualise the relationship of the three sustainable energy pillars and the selected modelling metrics with the Sustainable Developments Goals (SDGs). Energy is the golden threat through the 2030 Agenda as achievement of all goals is directly or indirectly linked to the universal supply of sustainable energy. Some goals are more directly related to energy, such as SDG 19, SDG 11, and SDG 13, while others are influenced more indirectly.


ENERGY FOR QUALITY OF LIFE
ENERGY AND ENVIRONMENT
SDG1: No Poverty
SDG3: Good Health & Wellbeing
SDG2: Zero Hunger
SDG7: Affordable and Clean Energy
SDG6: Clean Water and Sanitation
SDG15: Life on Land
SDG14: Life Below Water
SDG17: Partnerships
Energy for Sustainable Development
SDG13: Climate Action
SDG11: Sustainable Cities and Communities
SDG12: Responsible Consumption and Production
SDG4: Quality Education
SDG5: Gender Equality
SDG16: Peace, Justice & Strong Institutions
SDG9: Industry, Innovation & Infrastructure
SDG8: Decent Work & Economic Growth
SDG10: Reduced Inequalities
ENERGY SECURITY

29. Two constraints[7] can be utilized in the implementation within the Policy Scenarios:

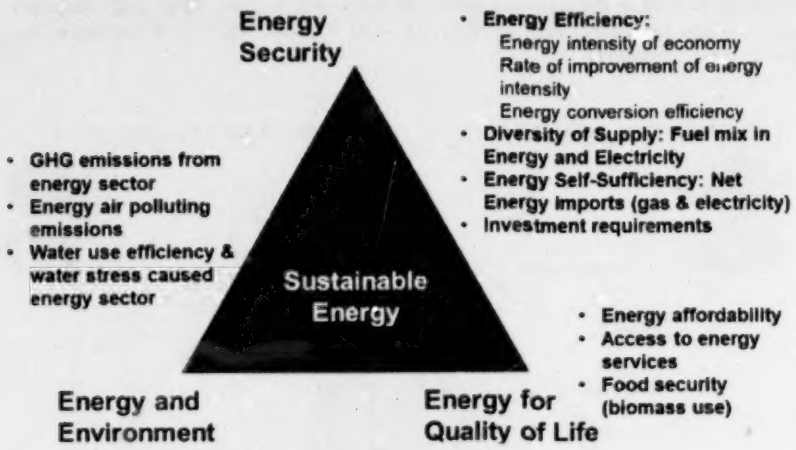
(a) Limit cumulative global greenhouse gas (GHG) emissions from the energy sector over the remainder of the 21st Century to stay below the 2oC maximum temperature limit;

(b) Reduce air polluting emissions from energy sector: Sulphur Dioxide (SO2), Nitrogen Oxides (NOx), Particulate Matter (PM2.5), possibly others; in ppm or µg/m3. Sub-regional specific targets can be established and implemented for the Policy Scenarios, if desired by the Committee.

30. Figure (iv) provides a simplified overview of selected metrics for each of the three sustainable energy pillars. The Committee will be presented with this preliminary selection of Key Performance Indicators (KPIs) that can be used in the models. The KPIs function mainly as output indicators, rather than input assumptions. The team selected three to four metrics across the three pillars to play a more prominent role in the scenario analysis and presentation within an ECE context. Some of these metrics will function as Long-Term Performance Goals, some others as Key Performance Indicators (see glossary). Some of them might also become signposts, however, the discussions are still ongoing, and the Expert Groups are requested to provide comments over the course of the remaining project period. The detailed list of metrics is summarized in the Annex. Chapter II "Draft List of Key Performance Indicators" The Committee will be requested to endorse the selected

[7] defined modelling outcomes in 2050, see glossary.

metrics, the constraints and the definition of sustainable energy. This will allow the finalisation of signposts and KPIs in the remaining half of the project implementation period.


Energy Security
• Energy Efficiency:
Energy intensity of economy
Rate of improvement of energy intensity
Energy conversion efficiency
• Diversity of Supply: Fuel mix in Energy and Electricity
• Energy Self-Sufficiency: Net Energy imports (gas & electricity)
• Investment requirements
• GHG emissions from energy sector
• Energy air polluting emissions
• Water use efficiency & water stress caused energy sector
Sustainable Energy
• Energy affordability
• Access to energy services
• Food security (biomass use)
Energy and Environment
Energy for Quality of Life

C. Policy dialogue, stakeholder workshops and formulation of adaptive policy pathway

31. The project's approach is strengthened by a continuous dialogue among countries and other stakeholders on how to attain sustainable energy. Policy dialogues among ECE member States as well as within ECE sub-regions have led to an increased understanding of countries on how to formulate and subsequently implement effective and equitable strategies and policies towards sustainable energy.

32. So far, countries have had the opportunity to share their understanding about how to achieve sustainable energy through a series of workshops. Such workshops include kick-off workshops, ECE-wide policy workshops, technical workshops to discuss modelling metrics and approaches, and the first sub-regional workshop for Central Asia, from 12–14 June 2018 in Kyrgyzstan.[8]

33. Additional research on policy options and existing literature on adaptive and cross-cutting policies will provide the link between different energy-relevant sectors and policy objectives. The Committee and its subsidiary bodies will be asked to provide inputs into the development and validation of policy pathways throughout the remaining project period (see Chapter VI).

[8] See workshop documentation: https://www.unece.org/energywelcome/committee-on-sustainable-energy/committee-on-sustainable-energy/energycommitteemeetings/committee-on-sustainable-energy/committee-on-sustainable-energy/2018/stakeholder-consultation-workshop-national-sustainable-energy-action-plans-scenarios-for-central-asia/docs.html

V. Major challenges and need for action

A. Need for increased stakeholder engagement

34. Over the course of the last year, the modellers, the Advisory Board and the Bureau have highlighted the need for additional sub-regional workshops to increase stakeholder engagement by inviting their contributions to the formulation of project results. Stakeholder engagement is further important to ensure that the set of scenarios and pathways provide useful, applicable and acceptable information for the highly diverse ECE member States.

35. Sub-regional workshops can be useful to deepen the discussion in a specific context. So far, the project team has only organized one sub-regional workshop in Central Asia. Sub-regional workshops intend to increase the understanding among countries about the differences in sustainable energy perspectives, seek to provide new insights into sub-regional approaches, and offer an opportunity to improve the models. This is particularly important for the four newly formed sub-regions within the MESSAGE model: Belarus-Moldova-Ukraine, Caucasus, Central Asia, and the Russian Federation, as the disaggregation of these sub-regions requires substantive additional research and formulation of modelling input assumptions.

36. For the remaining project period, the last opportunity for stakeholder engagement is given at the information and consultation workshop on 24 September 2018, and the sessions planned at 9th International Forum on Energy for Sustainable Development in Kiev from 12–15 November 2018 (see Chapter VI-B). To facilitate further stakeholder engagement and organize additional sub-regional workshops, additional funding is required.

B. Need for stronger involvement of subsidiary bodies in the formulation of policy pathways and the development of early-warning system indicators

37. The project has been presented to four Groups of Experts sessions, namely of renewable energy (GERE), energy efficiency (GEEE), coal mine methane (CMM) and cleaner electricity production from fossil fuels (CEP). While all the expert groups have expressed interest in further collaboration, their actual involvement is insufficient to lead to the development of robust policy formulations that would lead to sustainable energy and provide inputs on early-warning system signposts and indicators.

38. Now that intermediate project results are available, the involvement of the expert groups would contribute to the development of practical and solid recommendations in the respective field and would help test approach and recommendations in the widest manner. This could be done by either nominating dedicated "Pathways focal points" in each expert group, or by setting up a task force with representatives from each of the expert groups.

C. Project extension of phase I

39. The selection and contracting of the modelling institution took longer than expected. IIASA could only be recruited at end of April 2017, leading to a delay in the commencement of the modelling work of about six months.

40. The project has been extended to October 2019, taking into consideration a delayed start and the need for additional stakeholder engagement.

VI. Outlook: Milestones for the remaining project period (phase I until October 2019)

A. Policy dialogue at the twenty-seventh Committee session

41. The first Committee-wide policy dialogue about intermediary modelling results will be held at the twenty-seventh session. Member States will have the opportunity to comment on intermediate project results and to discuss policy options and potential sustainable energy policy pathways. The discussion will comprise the challenges and opportunities linked to any transition. The objective of the exchange is to initiate the work on adaptive policy pathways and early warning systems, milestones that are also part of phase I.

42. The dialogue with the Committee will allow the development of 4-5 policy scenarios that will be developed during the timeframe between 2018 and 2019. The Committee's inputs will further shape the project's work plan for the remaining deliverables, including further analysis through sub-regional, policy or technology deep dives, depending on the wishes of the Committee and available resources.

43. The forthcoming Committee session is therefore a unique opportunity to prepare the high-level political dialogue planned for the second half of 2019.

B. Stakeholder engagement workshops until October 2019

1. Pathways Workshop on 25 September 2018

44. A project workshop is planned on 25 September 2018, a day before the policy dialogue at the twenty-seventh session of the Committee. The workshop will allow member States and energy experts to understand the status of the project beyond what can be discussed in the short time during the Committee. Members of the project team will brief interested participants and invite reactions.

2. Several sessions about various angles of the project at the 9th International Forum on Energy for Sustainable Development (IFESD) in Kiev from 12–15 November 2018

45. Ukraine will host the 9th IFESD in Kiev from 12–15 November 2018. The proposal at the time of writing this document is to hold five sessions about the project: i) two sub-regional workshops, one for Belarus, Moldova and Ukraine and one for the Caucasus region; ii) a session on scenario results and policy pathways; iii) the role of renewable energy in sustainable energy pathways, and (iv) the early-warning system conceptualisation.

46. Additional funding for participant travel and speakers would maximize the outcome of all sessions.

3. Additional sub-regional workshop(s)

47. Subject to funding and country demand, additional sub-regional workshops could be organized between January and September 2019. Sub-regions could for example comprise North America, the Russian Federation, and Central and Eastern Europe.

48. The implementation of these additional tasks requires the availability of extra funding for participant and staff travel, staff and logistical support.

C. High-level policy dialogue, 2nd half of 2019

49. Building upon the outcomes from the Committee's policy dialogue at its twenty-seventh session, it is planned to evaluate the results of the scenario work and the policy pathways in a high-level policy dialogue format at the end of 2019 and subject to a host-country. At this stage, location, format and seniority of attendants are still undecided, and the Committee's views are welcome. Extrabudgetary funds will be required.

50. Ideally, such a high-level policy dialogue takes place in Q3 2019. One option is for the Committee to hold the dialogue in the context of its twenty-eighth session in Geneva. In preparation, the Committee could meet on 16 May 2019 to define the format, participants, content and location of the high-level policy dialogue. At that occasion, experts could refine the scenario results and adaptive policy pathways.

VII. Planning phase II (2019–2021)

51. The Committee has always stressed the need for continued dialogue about how to attain sustainable energy. As such, the project is only the starting point for more in-depth policy and technology analysis in the ECE region, and that with a view to developing recommendations for ECE countries on the different pathways that are available to achieve a desired future.

52. The current project – after the prolongation - will end in October 2019 if no further funding will be made available. At its twenty-seventh session, the Committee will be asked to recommend steps for the future and initiate planning for a potential phase II. A unique opportunity exists at this time to build upon the modelling structure that has been developed for ECE sub-regions. The model can now be used for a variety of outputs. The Committee is presented with the following initial set of ideas for additional activities. These are simply ideas to begin an exchange about the possibilities with the Committee and international experts and partners.

A. Regional and/or sub-regional deep dives

53. Additional sub-regional deep dives together with workshops, based on the results from phase I. Depending on demand, this analysis could include a deeper assessment of scenarios and their consequences in selected sub-regions, for example, Central Asia, with a focus on the energy-water-food-nexus challenges or scenarios on how to achieve energy security (energy self-sufficiency versus intraregional cooperation and trade). Another example could be the assessment and consequences of a combined European Union and Eurasian Economic Union market. Additional modelling work could focus on the country-level disintegration of selected sub-regions (e.g. Central Asia, Caucasus, etc.) to provide deeper analysis of countries' roles and opportunities in a sub-regional context. More country-specific scenarios and policy options could derive from this analysis. The approach could include partnering with other United Nations Regional Commissions.

B. Technological or subject-based deep dives

54. Additional analysis of existing scenarios in form of deep dives, with the possibility of a variety of topics. Suggested deep dives comprise affordability of energy; the cost of stranded assets (investment requirements in modernizing energy infrastructure); health (incl. air, food and water); disruptive technologies (hydrogen, power-to-gas (PtG) and power- to-liquid (PtL); renewable energy system integration including the role of gas; time

for diffusion and development of new technologies; resource availability for new technologies; digitalization and energy, including blockchain; energy productivity and energy efficiency; waste to energy; inter/intra-regional trade, regional cooperation and market integration; role of external influencers to the ECE region (e.g. China); biomass; infrastructure and infrastructure resilience.

C. Implementation of policy pathways

55. Support of the implementation of adaptive, cross-cutting and holistic policies in a sub-regional or national context, connected closely to any tracking initiatives of the 2030 Agenda implementation. Selected countries could be supported in identifying the most suitable policy pathway, and subsequently, receive support in the implementation of the chosen approach. This could further be linked to the tracking of SDG targets, such as SDG 7 (see also section VII(F)).

D. Capacity development

56. Selected countries and their stakeholders could be supported in developing skills on the model application and usage of modelling results for further purposes, to provide support in the analysis and assessment of policy options based on national circumstances, and the implementation of recommendations and policy pathways.

E. Application of the early-warning system

57. Establishment of an early-warning system in one or more pilot countries in cooperation with the Ministry of Energy and Statistical Office. This should include the set-up of the measurement, verification and reporting system to track signposts, assess progress towards achieving the sustainable energy goals and to test the functionality between adaptive policy pathways and signposts.

F. Tracking progress toward the achievement of sustainable energy

58. Development of a progress report tracking achievement of all energy-related SDGs as proposed by the project, including reporting on signpost data, and that further tracks implementation of suggested policy options. The set-up of a dedicated tracking progress task force under the Committee could be beneficial to lead this work. This work should be linked to the World Bank, IEA and IRENA led official SDG 7 progress tracking to which ECE contributed with a dedicated regional report in 2017.[9]

VIII. Conclusions

59. At its twenty-seventh session, the Committee will be invited to:

(a) endorse the definition of the sustainable energy objectives and the selected sustainable energy metrics across the three sustainable energy pillars as defined in this document;

[9] The report can be downloaded online: https://www.unece.org/fileadmin/DAM/energy/images/CSE/publications/Global_Tracking_Framework_-_UNECE_Progress_in_Sustainable_Energy.pdf

(b) make suggestions on policy pathway formulations and selected sub-regional or technical deep dives;

(c) request the increased involvement of its six subsidiary bodies and submission of inputs in preparation of the final project outputs, in particular through (1) research on existing policies, and suggestion for possible policy options in their respective area; (2) development of adaptive, cross-cutting and holistic policy options; and (3) reactions on targets, metrics, and signposts as basis for the early-warning system. Such feedback is requested no later than the preparatory meeting of the Committee on Sustainable Energy on 16 May 2019;

(d) endorse the organisation of a high-level policy dialogue in Sep-Oct 2019, and make recommendations on its location, content and format. Such a policy dialogue could be held during the twenty-eighth session of the Committee on Sustainable Energy in Geneva and would extend to at least half a day. Should a country step forward to host such a policy dialogue, the Committee requests the sustainable energy sub-programme to begin preparations under regular consultation with the Bureau;

(e) request an additional session of the Committee on 16 May 2019 to endorse policy recommendations for ministerial roundtables that will conclude the first phase of the project;

(f) discuss and propose activities for follow-up phases of the project beyond October 2019;

(g) recommend possible sources of funding for future activities; and

(h) empower its Bureau to decide on behalf of the Committee on all questions related to the implementation of the project.

Annex

Pathways to Sustainable Energy: General Project Information, Draft List of Key Performance Indicators and Timeline October 2016 to October 2019

I. Project set-up, management and steering

A. General project information

1. Project Title: Pathways to Sustainable Energy.

2. Project duration for phase I: 1 October 2016 to 31 October 2019.

3. The overarching objective of the project is "The capacities of ECE member states to develop, implement and track national sustainable energy policies aligned with international agreements are increased and contribute to climate change mitigation and sustainable development". To achieve this objective, the Committee agreed on the definition of three expected accomplishments:

1. Output 1: Modelling of Sustainable Energy Scenarios

4. Results from the modelling of sustainable energy scenarios for the ECE region enable the identification of policy options and inform national energy strategies of member States.

2. Output 2: Conceptualisation of an Early-Warning System

5. A mechanism tracking implementation of international climate and sustainable development agreements is conceptualised and information is disseminated to member States.

3. Output 3: Policy Dialogue and Formulation of Adaptive Policy Pathways

6. The understanding and capacities of national energy ministries to develop, implement and track national sustainable energy strategies is increased, adaptive policy pathways are developed, and a regional dialogue exchange format is established.

B. Project governance and management

7. The Committee on Sustainable Energy oversees the project and provides steering and guidance to its implementation during its annual sessions. As an intergovernmental body, the Committee functions as the mandate giving body that provides overall strategic decision-making. In between sessions, the Bureau of the Committee provides steering and receives regular updates of the implementation progress by the secretariat, as requested by the Committee in its earlier sessions.

8. The secretariat set up a Technical Advisory Board, which consists of members that allow a broad representation of the ECE region in terms of sub-regions as well as institutional background, including public and private sector, civil society and academia.[10]

[10] The members of the Advisory Board can be seen on the project website: https://www.unece.org/index.php?id=46917.

The Advisory Board provides substance knowledge and feedback on preliminary results and proposals and acts as a sounding board.

9. At this stage, three donors support the project financially: Germany, the Russian Federation, and the United States. Funds are dedicated to the modelling institutions to support the implementation of the project until the end of phase I (see next paragraph), to support limited participant travel to attend regional stakeholder workshops and policy dialogues and to project management undertaken by the secretariat (four-person months).

10. Fraunhofer ISI and UMSICHT, IIASA as well as PNNL will support the implementation of activities across all three output areas. IIASA and PNNL will provide the modelling of the sustainable energy scenarios and Fraunhofer will provide the assessment of technology options to be used within the scenarios. Figure (v) summarizes the cooperation among the three organisations.

11. The secretariat is responsible for the day-to-day project management to coordinate modellers, implement activities as outlined in the concept note, facilitate stakeholder engagement and represent the project at events, and conduct monitoring and reporting tasks.

12. The project seeks to include a broad range of stakeholders and is open for the contribution and participation of additional partners, donors and experts.

II. Draft list of Key Performance Indicators (KPIs)

A. Pillar I: Energy security

1. Energy Efficiency, expressed through three metrics:

13. (1) Energy intensity: units of energy per unit of GDP (in Joule per US$ Purchasing Power Parity (J/US$ PPP)) (SDG7.3 indicator); (2) Rate of improvement in energy intensity (CAGR – Compound annual growth rate) (SDG7.3 indicator); and (3) Conversion efficiency. The chosen metrics relate to the SDG 7.3 target „double the rate of improvement in energy efficiency by 2030", and will be interpreted in the context of both thermodynamic conversion efficiency as well as the energy efficiency of the economy.

2. Fuel Mix in Energy and Electricity

14. Expressed as share of different fuels in Total Final Energy Consumption (TFC) and Total Primary Energy Supply (TPES), and in electricity, in percentage. The metric relates to the SDG 7.2 target „substantially increase the share of renewable energy in TFC", and will be interpreted in the context of diversification of energy supply and the share of low-carbon / fossil fuel energy supply.

3. Net Energy Imports

15. Expressed as net imports in each sub-region and overall ECE region for all essential fuel. The metric relates to SDGs 8 and 9, and will be interpreted in the context of regional cooperation, interconnectivity and energy self-sufficiency.

4. Investment requirements to achieve sustainable energy

16. Expressed as energy investment of GDP, in percentage. The metric relates to SDG 7.A., and SDG 13.A. and will be interpreted in the context of impacts and financeability.

B. Pillar II: Energy and environment

1. Total GHG emissions from the energy sector

17. Expressed as total global GHG emissions of the energy sector in MtCO2eq. The metric is implemented as a modeling constraint, and further relates to SDG 13. The target value is to "limit cumulative total global greenhouse gas emissions of the energy sector over the remainder of the 21st Century to stay below the 2°C maximum temperature limit. (about 890-900 Gt CO2)".

2. Air polluting energy emissions

18. Expressed as emissions from the energy sector: Sulphur Dioxide (SO2), Nitrogen Oxides (NOx), Particulate Matter (PM2.5); in ppm or µg/m3. The metrics relate to SDG 3.9.1. If the Committee desires, it is possible to implement emission targets as modeling constraints for the different sub-regions as part of the policy scenarios.

3. Water use efficiency and water stress caused by the energy sector

19. Expressed through two metrics: (1) Cooling water use of electricity generation (l/kWh), and (2) water use associated with energy resource extraction (in terms of GJ liters absolute and/or L/GJ). The metric relates to SDG 6.4.1 "substantially increase water use efficiency", and 6.4.2 „substantially reduce water scarcity ". The metrics will be interpreted in the context of water use of the energy sector in power generation and water consumption from energy extractive industries.

C. Pillar III: Energy for quality of life

1. Energy affordability

20. Expressed as total energy expenditures per GDP per capita. The metric relates to SDG 1 and SDG 7, and will be interpreted in the context of energy poverty and household income spent on energy expenditures.

21. The Bureau expressed as a desired target range for the output value: Maximum 10% of disposable income spent on energy expenditures.

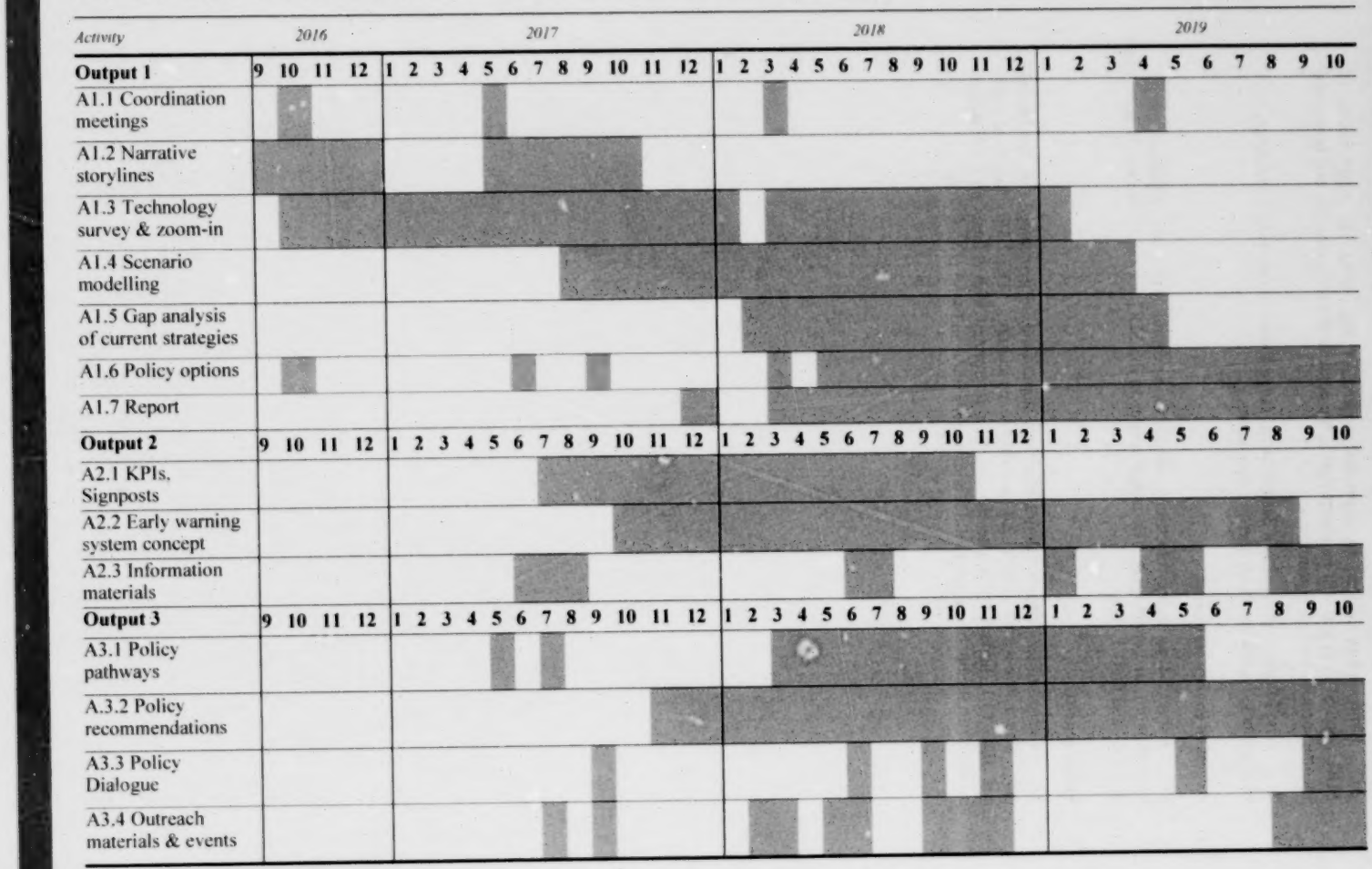
2. Access to energy services

22. Expressed as energy/electricity services per capita (efficiency adjusted energy consumption), in J/capita/year. The metric relates to the SDG 7.1 target "universal access by 2030" and SDG 1.

3. Food security

23. Expressed as share of calories from non-staple food, in percentage (GCAM model only). The metric relates to SDG 2.4 (sustainable agriculture), SDG 2.3 (reduce food loss), and SDG 13.1 (impact of climate change). It is interpreted with a focus on the linkages between sustainable bioenergy (solid biomass) generation and food production.

III. Draft Activities Timeline October 2016 – October 2019 (Phase I)


Activity
2016
2017
2018
2019
Output 1
9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10
A1.1 Coordination meetings
A1.2 Narrative storylines
A1.3 Technology survey & zoom-in
A1.4 Scenario modelling
A1.5 Gap analysis of current strategies
A1.6 Policy options
A1.7 Report
Output 2
9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10
A2.1 KPIs, Signposts
A2.2 Early warning system concept
A2.3 Information materials
Output 3
9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10
A3.1 Policy pathways
A.3.2 Policy recommendations
A3.3 Policy Dialogue
A3.4 Outreach materials & events

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Committee on Sustainable Energy

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Item 4 of the provisional agenda
The role of the Committee on Sustainable Energy and its subsidiary bodies in supporting the 2030 Agenda on Sustainable Development

The role of the Committee on Sustainable Energy and its subsidiary bodies in meeting the 2030 Agenda on Sustainable Development

Note by the secretariat

Summary

This document maps activities carried out under the sustainable energy subprogramme of the United Nations Economic Commission for Europe that support countries in their pursuit of the Sustainable Development Goals, as set out in the 2030 Agenda for Sustainable Development (2030 Agenda).

In light of the accelerating transformation of the energy system and ongoing changes in the operational imperatives of the United Nations, the Committee on Sustainable Energy (the Committee) is invited to provide views and consideration to a structure and topical approach that would allow swifter reaction and increased impact on energy for sustainable development.

While the work of the Committee and its bodies is driven by global agreements and mandates from member States, scientific evidence, technical breakthroughs and geopolitical developments strengthen the need for a strategic rethinking of the work at hand. Global megatrends, including urbanization, the need for sustainable cities and raw materials management and a better understanding of the scientific and socio-economic relationships further call for a renewed view across operational connectivity and relevance.

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I. Introduction

1. This document maps activities carried out under the sustainable energy subprogramme of the United Nations Economic Commission for Europe (ECE) that support countries in their pursuit of the Sustainable Development Goals (SDGs), as set out in "Transforming our world: the 2030 Agenda for Sustainable Development" (2030 Agenda). It describes activities that support the follow-up and review of the 2030 Agenda across the SDGs and that aim to help countries develop national action plans for SDG implementation.

2. The work of the sustainable energy subprogramme is carried out through international policy dialogue, normative work, capacity-building and dissemination of good practices and lessons learned. Activities concentrate on the areas of energy efficiency, clean electricity production, renewable energy, coal mine methane, natural gas, resource management, and energy security.

3. This document must be seen in the context of the Secretary-General's ongoing efforts, at the request of the General Assembly, to strengthen the United Nations development system through streamlining activities. The reform seeks to enhance the capacity of the system to address the full range of sustainable development challenges in an integrated manner, as set out in the 2030 Agenda.

4. The 17 SDGs are universal, interlinked and indivisible and demand that the United Nations reinvent to better serve countries and people. To bring about transformational change, the Secretary-General has called on the principals of the United Nations development system to develop new mindsets and cross-cutting capacities to respond to a comprehensive and universal agenda; strengthen the capacity to mobilize partnerships and financing at scale to support country priorities; and generate synergies across the United Nations development system to deliver greater results for people.

5. In consequence, the ECE Executive Committee (EXCOM) was informed by the ECE Executive Secretary of her proposal to enhance ECE's role in assisting countries with advancing SDGs.[1] The nine SDGs that define the core specialization of ECE are SDGs 3, 6, 7, 8, 9, 11, 12, 13 and 15.[2] These SDGs largely overlap with the gaps identified in the first report of the Secretary-General on the repositioning of the United Nations development system as a whole.

6. To strengthen the impact of its work and within current mandates, ECE intends to enhance activities in the areas covered by these nine SDGs. Four possible high-impact areas have been singled out as a result of the ongoing reflection with EXCOM at ECE level:

(a) Sustainable use of natural resources;

(b) Sustainable and smart cities;

(c) Sustainable mobility and smart connectivity;

(d) Measuring and monitoring SDGs (methodology).

7. The emphasis will be on delivering concrete results that show progress on the implementation of the 2030 Agenda at the country and regional level (the so-called "do-tank") taking full advantage of ECE's convening power, inclusiveness, and technical excellence.

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[1] Ninety-eighth meeting of EXCOM on 18 May 2018: "Main directions of UNECE ongoing work on further SDG alignment" (informal document no. 2018/12)

[2] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

8. 2018 is also the year in which progress of SDG 7 implementation will be assessed at the High-Level Political Forum in New York (HLPF), 9–18 July 2018.[3] The outcomes of the review will be reported at the twenty-seventh session of the Committee on Sustainable Energy (the Committee) and might influence the Committee's future programme of work.

9. This paper has been prepared for the Committee as a basis for discussion about how the activities of the Committee and its subsidiary bodies might provide better support to member States as they undertake to attain "energy for sustainable development", given the series of parallel reform mechanisms and review processes mentioned above. Other ECE Committees are undergoing similar reflection periods, so the Committee is well aligned with an ECE-wide process.

10. The reform of the United Nations development system is an ongoing process and Member States will decide on its final shape, however, the Committee and its subsidiary bodies must be ready to implement requests swiftly and in line with the trends of the ongoing fast-paced energy transition to remain relevant for member States.

11. The intent is to open a strategic exchange on near-term priorities for the sustainable energy sub-programme, longer-term objectives that will shape its resources and structure, and decision-making procedures. In its session, the Committee will have the opportunity for a strategic dialogue leading towards a Committee vision, mission and strategy based on agreed opportunities and challenges. While the work of the Committee and its bodies is driven by existing mandates from member States, diverse factors such as scientific evidence, technical breakthroughs and geopolitical developments strengthen the need for a strategic rethinking of the work at hand. It is hoped that the Committee will express support for a continuing conversation based on this document so that proposals and a roadmap for implementation can be presented for adoption at the Committee's twenty-eighth session in 2019.

II. Background

12. The objectives of the sustainable energy subprogramme are set out in the 11 April 2013 Commission Decision A (65) on the Outcome of the Review of the 2005 Reform of ECE (including subsection II E) and the Executive Committee decision of 4 December 2013 on the terms of reference of the Committee and mandates and terms of reference of its subsidiary bodies.

13. Responsibility for the subprogramme is vested in the Committee. The subprogramme is implemented under the overall oversight of EXCOM and is serviced by the Sustainable Energy Division.

14. The Committee is an intergovernmental body that provides ECE member States with a platform for international dialogue and cooperation and is mandated to carry out a programme of work in the field of sustainable energy with a view to providing access to affordable and clean energy to all, in line with the 2030 Agenda, and to help reduce greenhouse gas emissions and the carbon footprint of the energy sector.[4]

15. The Committee oversees the following six subsidiary bodies: (a) Group of Experts on Energy Efficiency; (b) Group of Experts on Cleaner Electricity Production on Fossil Fuels; (c) Group of Experts on Renewable Energy; (d) Group of Experts on Coal Mine

[3] https://sustainabledevelopment.un.org/hlpf

[4] Revised draft programme of work for the ECE sustainable energy subprogramme for 2018-2019 (ECE/ENERGY/2017/11/Rev.1)

Methane; (e) Expert Group on Resource Classification[5]; and (f) Group of Experts on Gas. Further, the Committee engages in an energy security dialogue. It has taken interest in tracking progress of the energy-related SDGs (the regional component of the World Bank's "Global Tracking Framework"),[6] the project "Pathways to Sustainable Energy,"[7] modernisation of energy infrastructure and methane management in extractive industries and oversees these initiatives directly.

16. Work is oriented based on the attainment of the energy related SDGs. Attainment of SDG 7 is falling short in the ECE region except for the target on 100% access to electricity,[8] which is only one of the elements for ensuring access to affordable, reliable and modern energy services. Challenges and opportunities co-exist in access to modern energy services in the region and also in the world. If "access" were to be defined more broadly, then challenges remain on access to clean cooking fuel, technology, heating services and on reliability, affordability and quality of service, some of the aspects are included in the indicators for SDG 7.[9] The ECE region falls short as well on other energy-related indicators linked to improving quality of life. As noted above, the SDGs are universal, interlinked and indivisible. On current trends, energy will not deliver needed support to the 2030 Agenda.

17. The environmental impacts of the energy sector, particularly on climate change and air quality, are increasing at an alarming rate. In response, the Paris Climate Agreement has started to drive countries' actions and awareness. Current projections indicate that fossil energy will retain an approximately 70 to 80 per cent share of total primary energy by 2030, and this reality makes it imperative to address the environmental footprint of fossil fuels.[10] Many countries, communities, and people depend on fossil energy for incomes and livelihoods, and will do so for a foreseeable period beyond 2030. For many countries, the current political, regulatory, and industrial infrastructure is not ready for deep transformation, however, the angle of greening societies and competitiveness can play an important role, as can technology innovations and digitalization.

18. A notable and persistent gap is related to the financing of energy and industrial infrastructure, both in the context of modernising existing – aging and fossil based - infrastructure with the 2030 Agenda in mind and building cutting-edge, integrated, and new systems to the benefit of all and at affordable costs.

19. The social component of any systems transformation should not be neglected. Rapid transformation of economies that depend significantly on fossil energy will impact economic and social costs. The most vulnerable communities will need to adapt to the requirements of the new reality and confront fear of unemployment and inequality. Holistic strategies that take into account local resource bases, the social and technological conditions of countries, and the sovereignty of nations will allow countries to develop sustainable and inclusive low-carbon economies tailored to their needs, capabilities, expectations, and world views.

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[5] The Committee will be requested to approve a name change of the Expert Group on Resource Classification to Expert Group on Resource Management in its twenty-seventh session.

[6] Global Tracking Framework: UNECE Progress in Sustainable Energy (December 2017)

[7] Pathways to Sustainable Energy – Status Report (ECE/ENERGY/2018/1)

[8] Global Tracking Framework: UNECE Progress in Sustainable Energy (December 2017)

[9] https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%20refinement_Eng.pdf

[10] World Energy Outlook 2017, International Energy Agency

III. Contributions to supporting the energy-related Sustainable Development Goals

20. The present document summarizes the activities in the area of sustainable energy according to the Revised draft programme of work for the ECE sustainable energy subprogramme for 2018-2019 (ECE/ENERGY/2017/11/Rev.1).

21. The Committee's activities span a range of key SDGs beyond SDG 7, notably SDG 9 on industry, innovation and infrastructure; SDG 11 on sustainable cities and communities; SDG 12 on responsible consumption and production; SDG 13 on climate action; and SDG 17 on partnerships for the goals. The outcomes from the HPLF in New York will guide further work in this area.

Committee on Sustainable Energy	●	●	●	●	●	●
Group of Experts on Energy Efficiency	●	●	●		●	●
Group of Experts on Renewable Energy	●		●	●	●	●
Group of Experts on Cleaner Electricity Production from Fossil Fuels	●	●			●	●
Group of Experts on Coal Mine Methane	●	●	●	●	●	●
Group of Experts on Gas	●	●	●	●	●	●
Expert Group on Resource Management	●	●	◕	●	●	●

A. Group of Experts on Energy Efficiency

22. The Group of Experts on Energy Efficiency reported on the implementation of its Work Plan for 2016–2017 at the Committee's twenty-sixth session and has since been implementing the Work Plan for 2018–2019 according to schedule. Its key contributions to the 2030 Agenda over the time period are related to SDGs 7, 9, 11, 13, and 17 in several sectors.

23. In industrial energy efficiency, the Group of Experts has continued activities to close communication gaps between policy makers and policy end users (industrial companies). The Task Force on Industrial Energy Efficiency has been established as a platform to develop stronger linkages between different types of industrial energy efficiency stakeholders and to address barriers, including the perception that energy efficiency is a complex issue rather than an advantage to further industrial productivity.

24. The Committee on Sustainable Energy and the Committee on Housing and Land Management established the Joint Task Force on Energy Efficiency Standards in Buildings in 2015. As a first step, the two Committees endorsed the "Framework Guidelines on Energy Efficiency Standards in Buildings" in 2017. This process has set in motion the establishment of international centres of excellence and a consortium of educational and research institutions to promote and implement a high-performance buildings initiative, which showcased first results in a side event during the HLPF in New York on 11 July 2018. The Joint Task Force further completed a study on the mapping of energy efficiency standards in buildings in the ECE region and is in the process of mapping energy efficient technologies in buildings in the region. It has also started a training programme on high-performance energy efficiency standards in buildings for building sector practitioners, policymakers, and trainers.

B. Group of Experts on Cleaner Electricity Production from Fossil Fuels

25. The Group of Experts on Cleaner Electricity Production from Fossil Fuels reported progress on the implementation of its Work Plan for 2016–2017 at the Committee's twenty-sixth session and has since further implemented the 2018–2019 Work Plan according to schedule.

26. Its key contributions to the 2030 Agenda and in particular SDGs 7, 9, 11, 12, 13 and 17 over the time period are related to work that seeks to reduce greenhouse gas (GHG) emissions from fossil fuel-fired electricity generation. Thus, the activities of the Group of Experts are at the heart of the Committee's mandate and are based on an honest dialogue about the opportunities and challenges of clean electricity production; the carbon capture, use and storage (CCUS); enhanced oil recovery with CO_2; advanced fossil fuel technologies for power generation; and evaluation of efficiency-enhancing measures for coal-fired power plants.

27. The Group of Experts is in the process of assessing the role that clean electricity production will play in future sustainable energy systems and will seek the Committee's views during the twenty-seventh session. As the global energy transition is accelerating, countries will choose different pathways to meet commitments they have made, including under the 2030 Agenda and the Paris Climate Agreement. This Group of Experts could provide valuable insights about reaching some of the low-hanging fruits of the global agenda, including on nexus, efficiency and renewable energy.

28. Work has now started together with the Group of Experts on Renewable Energy and the Group of Experts on Gas on the role of fossil fuels in supporting renewable energy deployment and thus encourage deeper renewable energy penetration in the region, as there is still a need for a rapid-response capacity to maintain balance in power networks to accommodate oscillations in the output of intermittent energy sources.

29. Innovation and structural change will also be addressed. Improving energy efficiency has been a focus of intensive energy research over the past two decades. As a result, there has been steady technological innovation towards increasing efficiency and reducing emissions from the power generation of fossil fuels, most notably from coal. Work will continue and thus strengthen the achievements of the 2030 Agenda in the areas defined above.

C. Group of Experts on Renewable Energy

30. The Group of Experts on Renewable Energy reported progress on the implementation of its Work Plan for 2016–2017 at the Committee's twenty-sixth session

and has since further implemented the Work Plan for 2018–2019 according to schedule. Its key contributions to the 2030 Agenda over the time period are related to SDGs 7, 11, 12, 13, and 17 in several areas.

31. Over the past three years, the Group of Experts has majorly contributed to closing the information and data gaps on renewable energy so persistent in the eastern parts of the ECE region through the work of the "UNECE Renewable Energy Status Report,"[11] jointly produced with the Renewable Energy Policy Network for the 21st Century (REN21) and in close cooperation with the International Energy Agency (IEA). This work allowed to establish a baseline for activities and helps track the uptake of renewable energy in the region. The joint report demonstrates that 17 countries in South East and Eastern Europe, the Caucasus, Central Asia and the Russian Federation - and home to more than 300 million people - lag in global developments both technically and financially despite significant untapped renewable energy potential. Huge opportunities for increasing renewable energy deployment exist, in particular, because in 2015 investments in renewable energy only amounted to USD 400 million, less than 0.2% of the global total, and declining from 2014. Future work will continue to refine datasets and tracking opportunities and seek the involvement of the financial sector for awareness and opportunities.

32. To address persistent barriers to accelerated uptake of renewable energy at the country level, the Group of Experts has been organizing so-called "Hard Talks" on renewable energy in this order in Georgia, Ukraine, Azerbaijan and Kazakhstan. New Hard Talks are being planned in Bosnia and Herzegovina, Montenegro, Serbia, and the Russian Federation over the time period.[12] These multi-stakeholder dialogues focused on possible solutions to existing barriers promote a demand-driven, highly visible debate which seeks to contribute elements to national action plans on renewable energy and to pathways to sustainable energy.

33. In this context, the Group of Experts has been facilitating the exchange of know-how and best practice approaches between experts from countries on how to increase energy production from renewable sources and better integrate the renewable energy sector into national energy systems. This approach intends to enable a favourable investment climate in close cooperation with key stakeholders and international partners.

D. Group of Experts on Coal Mine Methane

34. The Group of Experts on Coal Mine Methane reported progress on the implementation of its Work Plan for 2016–2017 at the Committee's twenty-sixth session and has since further implemented the 2018–2019 Work Plan according to schedule. Its key contributions to the 2030 Agenda over the time period are related to SDGs 7, 11, 12, 13, and 17 in several areas.

35. Coal production, transportation, storage and use account for roughly 40% of global greenhouse gas emissions. As coal mines are the fourth largest source of methane emissions – a much more potent greenhouse gas than CO_2 - minimising the environmental, health and safety impacts of coal production constitutes a priority for the Group of Experts. Ensuring the safe extraction, transport, and use of methane throughout the coal mine life cycle is therefore the prime objective of the Group of Experts.

[11] http://www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-renewable-energy-status-report.html

[12] http://www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-hard-talks.html

36. To support this objective, the Group of Experts is in the process of developing "Best Practice Guidance for Effective Methane Drainage and Recovery in Coal Mines," endorsed by ECOSOC Decision 2011/222. Recommendations target the reduction of both methane-related accidents and explosions in coal mines and greenhouse gas emissions from the whole value chain of the coal sector.

37. The movement towards zero methane-related fatalities and lower methane emissions from coal-mines is not universal, being impeded by a lack of awareness of available technologies and the guiding principles for methane drainage and use. In this context, the Group of Experts in close cooperation with its key partners such as the Global Methane Initiative (GMI) organized a number of awareness-raising and capacity-building events around the world. Seminars and technical sessions providing a platform for the exchange of knowledge and experiences between the governments, private sector and academia were held in Canada, Kazakhstan, and Poland. A fact-finding mission and a following capacity-building workshop were also organized in Colombia to assist the host country in its efforts to meet its environmental commitments and to lower its exceptionally high rate of methane-related accidents in coal mines.

38. To increase its reach and assure effective appiication of the promoted practices, the Group of Experts is in the process of establishing a worldwide network of the International Centres of Excellence on Coal Mine Methane. So far Centres have been established in China and in Poland, and three others are likely to follow. The Centres are designed as non-profit entities subject to the laws of the host country and operating under the auspices of the Group of Experts. They serve as platforms for discussion on safety, environmental and economic aspects of coal mine methane, support capacity-building activities in United Nations Member States, and facilitate the transfer of technology. Centres also contribute to further development of the Best Practices Guidance and cooperate with governments, NGOs, and industry in research activities.

39. Further, there is great potential for greenhouse gas reduction through proper management of abandoned mine methane. To this effect, the Group of Experts established a Task Force on abandoned mine methane and works on developing a publication thoroughly addressing safety, environmental, and economic aspects of this matter with partners.

40. Modernization of the energy sector cannot be avoided, nor should it be delayed further as the energy infrastructure in many countries throughout the region is aging or already at the end of its life-cycle. It is in any country's interest to undertake such structural transformation in the most cost-efficient manner and with the most holistic approach with a benefit for the whole economy in mind. The Committee has already been consulted twice on a project that explores the opportunities that lie in the transformation of large industrial complexes in a way that corresponds to the societal challenges and complexities that any structural change implies and that takes into account the long-term opportunities provided by the ongoing energy transition in innovation, digitalization and technology break-through. This project has a direct link to SDG 11 on sustainable cities, as many industrial sites have developed into large cities and agglomerations over decades, providing livelihoods for people based on a cluster of industrial conglomerates, small and medium-sized enterprises and basic industries.

E. Expert Group on Resource Classification

41. The Expert Group on Resource Classification reported progress on the implementation of its Work Plan for 2016–2017 at the Committee's twenty-sixth session and has since further implemented the Work Plan for 2018–2019 according to schedule. To be ready and supportive of Agenda 2030, the Expert Group has implemented many new initiatives such as extending the application of the United Nations Framework

Classification for Resources (UNFC) to renewable energy, anthropogenic resources and injection projects for storage of CO_2. Guidelines for social and environmental considerations and protocols for the delivery of SDGs have and are being developed to make UNFC a unique resource management system well aligned to the targets set out in the 2030 Agenda.

42. Given ECE's focus on sustainable use of resources, the transformation of UNFC into a comprehensive resource management system is one of the areas the Expert Group has proposed to focus on in the future. Its key contributions to the 2030 Agenda, and in particular SDGs 7, 9, 11, 13, and 17 over the time period, are related to work on all resources such as minerals, petroleum, renewable energy, anthropogenic resources and injection projects where emphasis has been placed on a UNFC resource management tool-kit, that will provide a significant focus on social and environmental aspects, and alignment to SDGs in areas such as zero-waste – zero-harm, circular economy, decarbonization, resilience and increasing efficiencies through comprehensive and integrated resource production. Given the refocus on sustainable resource management, the Expert Group recommends changing its name to Expert Group on Resource Management.

43. Key accomplishments over the time period include an increasing number of countries committing to apply UNFC. This includes initiatives such as "UNFC for Africa" led by the African Union Commission and "UNFC for Europe" led by the European Commission. Similar initiatives are being discussed for Eurasia, Asia-Pacific and Latin America. ECE has entered into partnerships with the European Federation of Geologists, EuroGeoSurveys (an association of 37 national and regional geological services in Europe), the Organization of African Geological Surveys (OAGS) and the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP). Discussions are progressing with the Association of Geological and Mining Services in Iberoamerica (ASGMI) and the Latin American Mining Organization (OLAMI). The Nordic countries (Finland, Norway and Sweden) have developed sub-regional UNFC guidelines, and the Russian Federation and China have finalized bridging documents between UNFC and their national systems. The International Renewable Energy Association (IRENA) in partnership with the International Geothermal Association (IGA) and the World Bank have started a project to apply UNFC to geothermal energy in a number of countries. Mexico has initiated a project to test UNFC for sustainable management of petroleum projects as a prelude to the application of UNFC nationally for all resources.

F. Group of Experts on Gas

44. The Group of Experts on Gas reported progress on the implementation of its Work Plan for 2016–2017 at the Committee's twenty-sixth session and has since further implemented the Work Plan according to schedule. The Group of Experts on Gas focusses on: Role of gas in attaining the SDGs; Best practices in managing methane emissions along the gas value chain; Role of gas in improving urban air quality; Renewable energy and natural gas as the best combination to enhance the energy efficiency in the whole energy system; Emerging issues (biogas and biomethane, synthetic gas, power-to-gas, hydrogen, carbon capture and storage) and Promoting sustainable and clean production, distribution, and consumption of gas and Liquefied Natural Gas (LNG) in the ECE region.

45. The Group of Experts recommends to ECE member States to leverage the existing conventional natural gas infrastructure as a cost-effective entry point for developing low- or zero-emission alternatives, such as biogas, biomethane, synthetic gas, power-to-gas (hydrogen and syngas), or carbon capture and storage.

46. Its key contributions to the 2030 Agenda over the time period are related to work on exploring how gas and LNG can help ECE member States to attain SDG 7 on energy, but

also SDGs 1, 2, 5, 6, 9, 11, 12 and 13. This has taken place through multi-stakeholder policy dialogues and other events in partnership with organizations such as the International Gas Union (IGU), Marcogaz and the Global Methane Initiative.

47. The Group of Experts has noted that natural gas is an important tool in reducing concentrations of airborne pollutants and hence improve urban air quality, which is important for SDG 11. ECE has entered into a MoU with IGU. As a result, IGU released its Urban Air Quality report at the fifth session of the Group of Experts. With technical input from the World Health Organization, the Group concluded that fuel switching from solid fuels to natural gas is a highly effective measure for improving local and regional ambient air quality. The Group is now working to develop policy recommendations for ECE member States and the other United Nations Member States on the role of gas in improving urban air quality.

48. The Group published a report on "Removing Barriers to the Use of Natural Gas as Maritime Transportation Fuel." The report demonstrates the business case for using Liquefied Natural Gas (LNG) as a fuel in maritime transport, for both LNG tankers and – increasingly since 2000 – other ships. Currently, there are over 300 ships powered by LNG. LNG offers significant environmental benefits compared to heavy fuel oil and diesel both of which dominate today's market for international shipping bunkers. The report identifies drivers, key enablers, gaps and barriers to the use of LNG as a fuel in maritime transport. Reducing the use of heavy hydrocarbons and increasing the use of LNG in maritime transport could help reduce CO_2 emissions and other pollution arising from international trade.

49. A practical case study on how trucking of LNG could help ensure access to affordable, reliable, sustainable, and modern energy services to various communities and businesses in Spain was also published as a result of the work and research of the Group of Experts. The transportation of Liquefied Natural Gas (LNG) via truck loading is a fast-growing vector of natural gas delivery and the main alternative to supply via pipelines. In some situations, LNG delivered by refrigerated trucks may prove to be the most cost-effective solution to reaching communities that at present do not have access to modern energy services. In this regard, LNG could play an important role in reducing the carbon intensity of the energy sector in many ECE member States and, at the same time, help them achieve the relevant SDGs.

50. In many ECE member States, there is an opportunity to improve efficiency and reduce methane emissions along the entire gas value chain. Methane emissions from the gas value chain reduce the climate benefits of natural gas and could, if emissions are significant, undermine the role of gas in the energy system of the future. The project: "Methane Management in Extractive Industries (Upstream Oil and Gas/Downstream Gas)", funded by the United States Environmental Protection Agency (USEPA) in cooperation with the Group of Experts has now started. As well as the development of Best Practices in managing methane emissions along the gas value chain, the Group is also working on case studies on best practices for measuring, reporting, verifying, and reducing methane emissions throughout the gas value chain.

IV. Starting a strategic dialogue about impact and realignment on energy for sustainable development

51. Current activities of the Committee and its subsidiary bodies comprise the work plans of the respective bodies and cover energy efficiency, renewable energy, cleaner electricity, coal mine methane, gas, resource management and energy security. While the interaction between the groups has been improving, as a general practice they have

operated independently of one another. A key question for member States is whether the current composition and interaction of the Committee and its subsidiary bodies adequately supports them in meeting the challenges they face.

52. While the work of the Committee and its bodies is driven by global agreements and mandates by member States, diverse technical breakthroughs, and geopolitical developments strengthen the need for a strategic rethinking of the work at hand. Global megatrends, including urbanization, the need for sustainable cities and raw materials management and a better understanding of the scientific and socio-economic relationships further call for a renewed view across operational connectivity and relevance. The desired end points, in a technologically agnostic manner for the energy sector, is to improve systemic efficiency, higher environmental performance and enhanced quality of life.

53. Regarding broader thematic activities, the work of the Committee and its subsidiary bodies could be described as falling into three nominal clusters:

(a) Reducing the environmental footprint of fossil energy, including work on carbon capture and storage, high-efficiency low emissions technology, methane management in the extractive industries, energy efficiency in industry, resource management, and positioning the use of fossil energy to accelerate the uptake of renewable energy;

(b) Sustainable resource management, including work on developing a comprehensive resource management tool, deploying best practice guidance on coal mine methane, renewable energy, and enhancing the contribution of LNG;

(c) Deep transformation of the energy system towards a 2-degree pathway, including work on the project "Pathways to Sustainable Energy" and progress tracking for energy-related SDGs and indicators; exploring decarbonization pathways; energy market design including high-performance buildings and sustainable human settlements, balancing markets, energy and mobility; and modernization of energy infrastructure.

54. The Committee is invited to shape its future approach to sustainable energy in ways that take account of the major challenges countries face and the activities of other organisations and partners. The exercise would involve rethinking the opportunities, outputs, and deployment for greatest impact.

55. The secretariat considers the following activities to be well aligned with the factors set forth above for priority-setting:

(a) Development and deployment a sustainable resource management system aligned with the 2030 Agenda;

(b) Accelerated implementation of the high-performance buildings initiative: energy efficiency, affordability, connections to sustainable human settlements, accelerated uptake of renewable energy;

(c) Market design for electricity and gas: system complexity, energy as a service, and acceleration of uptake of low-carbon technology;

(d) Renewable energy: best practice policies and financing;

(e) Pathways to achieving the 2030 Agenda for energy, national sustainable energy action plans, progress tracking (including relevant indicators);

(f) Methane management in extractive industries.

56. Further, the Committee and the subprogramme are involved in a number of cross-cutting activities and events:

(a) International Fora on Energy for Sustainable Development;

(b) Technical cooperation and advisory services;

(c) Hard Talks (on renewable energy; other);

(d) ECE regional fora on sustainable development;

(e) High-Level Political Forum;

(f) International Centres of Excellence;

(g) Memoranda of Understanding with partners; and

(h) UN-Energy and SDG 7 Technical Advisory Group to accelerate the implementation of 2030 Agenda.

57. The range of activities that ECE's sustainable energy subprogramme might undertake without resource limitations, while wide-ranging, is shaped by imperatives to focus on activities in line with mandates agreed by member States and to coordinate activities optimally with other organisations and member States. A list of possible activities is included in the Annex.

58. Resource limitations require member States to prioritise and focus on near-term activities that support a long-term view on helping accelerate attainment of the 2030 Agenda. As the programme's results bear fruit, its ability to attract extrabudgetary resources (including secondments and direct financial contributions) will grow progressively.

59. Choices regarding near-term activities in a longer-term context could consider the following factors in priority-setting:

(a) Alignment with the role of energy in supporting the 2030 Agenda;

(b) Alignment with the visions of the ECE Executive Secretary and the Secretary-General;

(c) Impact, scale, enduring effect;

(d) Political relevance;

(e) Visibility and reputational impact;

(f) Ease of communication and opportunity for resource mobilization;

(g) Foundation on ECE's unique contribution and role;

(h) Degree of completion by 2020; resource efficiency;

(i) Positive consequences for other elements of the ECE programme; and

(j) Available human resources.

60. In light of the need to accelerate transformation of the energy system and ongoing changes in the operational imperatives of the United Nations, the Committee is invited to provide views and consideration to a structure and topical approach that would allow swifter reaction and increased impact, including, but not limited to, re-organizing the Committee and its subsidiary bodies, with emphasis given to operational clusters in support of the 2030 Agenda as mentioned above and to nexus activities cutting across the current groups of experts, other Divisions, and other organisations.

61. Given the need to provide faster and more efficient guidance among the Committee, its subsidiary bodies, and EXCOM, consideration could be given to establishing terms of reference that enable decision-making when the Committee is not in session.

62. A starting point could be an agreed list of priorities identified over the course of 2018-2019 to realize the Committee's vision, mission, objectives and action plans until 2030. This list has got to be built on a set of pre-established criteria, possibly including urgency, established need by member States – in relation to the 2030 Agenda and based on staff resources (see also para. 60).

63. For reflection of both re-organization and terms of reference, the Committee could request a set of documents for consideration and endorsement at the twenty-eighth session of the Committee. Those documents would be developed with full engagement of member States and the broader stakeholder community over the coming year and will be in line with above mentioned developments in the United Nations system.

V. Conclusions and recommendations

64. The following draft conclusions and recommendations are put forward for consideration by the Committee at its twenty-seventh session:

65. In the light of the discussion at its twenty-seventh session, the Committee confirms the need to reconsider its mandate and programme of work going forward to ensure strategic alignment with the 2030 Agenda for Sustainable Development and:

(a) Approves the alignment of the programme of work not only with SDG 7, but also with SDGs 9, 11, 12, 13, and 17 and encourages nexus work and linkages through the sustainable energy subprogramme to be reflected in all efforts;

(b) Stresses the importance for countries to develop concrete pathways and solutions towards sustainable energy in the ECE region and requests its Bureau to develop a strategic plan for assisting member States comprising a vision, a concrete action plan, and a roadmap for implementation to be presented by the Chair for adoption at its twenty-eighth session in 2019. A list of priorities based on predefined criteria and needed staff resources should be included in the proposal;

(c) Recommends strengthening ECE's and the Committee's role as a neutral platform for policy and technology dialogues on the attainment of energy for sustainable development and to organise a Committee-wide strategic dialogue on 16 May 2019 to explore challenges and opportunities taking account of the findings and recommendations from the project "Pathways to Sustainable Energy." Further considerations could be the nominal or operational clusters presented to the EXCOM at its ninety-eighth meeting, the outcomes from the SDG 7 review process at the 2018 High-Level Political Forum, alignment with the 2030 Agenda, recommendations from the Ninth Forum on Energy for Sustainable Development, and nexus activities. The exercise must involve considering rethinking opportunities, resources, outputs, and deployment for greatest impact;

(d) Requests its six subsidiary bodies to play a leading role in shaping this document and requests the six Chairs to present at the next session their Expert Group's role in addressing these challenges. This report back could include recommendations on the effectiveness and efficiency of the current

composition and whether the current structure adequately supports them in meeting the challenges they face;

(e) Requests the Group of Experts on Cleaner Electricity Production from Fossil Fuels to take the lead in shaping the dialogue on energy transition and to partner with the other expert groups in the process for the report back at the Committee's twenty-eighth session;

(f) Requests the subprogramme to take steps towards implementing this request, supported by the necessary documentation, including, potentially, Terms of Reference for the Committee on Sustainable Energy, its Bureau and all subsidiary bodies, and with a view to allowing decision-making when the Committee is not in session;

(g) Wishes that documents be developed with full engagement of all member States over the coming year and be in line with ongoing reform developments in the United Nations system.

Annex

List of possible activities for the Committee on Sustainable Energy and its subsidiary bodies

I. Sustainable resource management

1. Develop and implement a comprehensive resource management system based on the United Nations Framework Classification for Resources (UNFC).

2. Continue to extend the application of the UNFC tool-kit for the entire value-chain and life-cycle of all resources, including strengthening the principles, specifications, guidelines, application protocols and best practices in alignment with the 2030 Agenda.

3. Provide training and capacity-building for sustainable resource management.

II. Energy transition

1. Pathways to the 2030 Agenda for energy, indicators, sustainable energy action plans.

2. Energy Security Forum.

3. Financing the transformation.

III. Energy efficiency

1. Accelerate activities on high-performance buildings: energy efficiency, affordability, connections to sustainable human settlements, accelerate the uptake of renewables

2. Improve industrial energy efficiency.

3. Improve transport energy efficiency (natural gas vehicles; e-mobility; biomass).

4. Improve conversion efficiencies of coal and other fossil fuels.

IV. Modernising infrastructure

1. Industrial/regional restructuring and reform; socio-economic impacts

V. Energy technologies and policies

1. Natural gas (shale best practices)

2. LNG standards

3. High-efficiency low emissions technology – dissemination and financing

4. Pursue gender and diversity issues in energy

5. Renewable energy: best practices and financing

6. Improve commercial prospects for carbon capture and storage

7. Remove barriers to nuclear power

VI. Electricity and markets

1. Market design in electricity and gas – systems complexity/energy as a service – and accelerate the uptake of low carbon technology

2. Explore quality of service regulation

3. Electric systems work (smart grids; balancing markets; market design)

VII. Methane management

1. Methane management in extractive industries

2. Other

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International Forum on Energy for Sustainable Development

Concept note and draft outcome document of the Ninth International Forum on Energy for Sustainable Development

Note by the secretariat

Introduction

1. Achieving Sustainable Development Goal 7 (SDG 7) of ensuring access to affordable, reliable, sustainable and modern energy for all is critically important for attaining the objectives of the 2030 Agenda on Sustainable Development (2030 Agenda). Energy is central to nearly every major challenge and opportunity the world faces today. The progress that has been made in achieving the SDGs – or lack thereof - shows that greater effort is needed on national and regional levels, including much bolder policy commitments, substantial increase in financing, and willingness to embrace the range of technology solutions on a much wider scale.[1]

2. The Ninth International Forum on Energy for Sustainable Development provides the opportunity to reflect on the challenges ahead and to agree on ambitious and concrete measures, presented to the Committee on Sustainable Energy in this document for consideration.

3. The event will take place in Kiev, Ukraine on 12-15 November 2018. It is jointly organized by the Government of Ukraine and the United Nations Regional Commissions in partnership with the United Nations Development Programme (UNDP), United Nations Institute for Training and Research (UNITAR), UN Environment, The World Bank, International Energy Agency (IEA), International Renewable Energy Agency (IRENA),

[1] Global Tracking Framework: UNECE Progress in Sustainable Energy (December 2017)

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International Atomic Energy Agency (IAEA), Global Environment Facility (GEF), Organization for Security and Cooperation in Europe (OSCE), International Energy Charter, International Energy Forum (IEF), Copenhagen Centre on Energy Efficiency, International Institute for Applied Systems Analysis (IIASA), Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT, Pacific Northwest National Laboratory (PNNL), Dartmouth College, and Climate Action Network (CAN).

4. The 53h session of the Group of Experts on Energy Efficiency and the fifth session of the Group of Experts on Renewable Energy will be held in the framework of the Ninth Forum.

5. This document provides background information on the approach to the Ninth Forum in the Concept Note (Annex I). Member States are invited to comment and endorse the draft Outcome Document of the Forum (Annex II).

Annex I

Concept Note of the Ninth International Forum on Energy for Sustainable Development

I. Energy for sustainable development

1. There is no commonly agreed definition of what energy for sustainable development is or how it will be achieved. As national circumstances vary significantly, countries will choose different pathways to meet commitments they have made, including under the 2030 Agenda and the Paris Climate Agreement. Analysis to date of the progress that has been made shows that much greater effort is needed, including much bolder policy commitments, substantial financing, and a willingness to embrace the range of technology solutions on a wide scale. Countries will act in ways that reflect their unique national circumstances to meet the commitments they have made. Their choices will be made in the broader context of their economies as a whole and can be expected to be economically and socially rational, targeting quality of life and not just access to affordable, modern, and clean energy.

2. The Ninth International Forum on Energy for Sustainable Development (the Ninth Forum) is an opportunity to reflect on the implications of accelerating and re-directing change. Technology innovation and decarbonization require accompanying social innovation, so the Ninth Forum will explore measures to close the gaps between action and ambition. Emphasis will be given to the resilience of energy infrastructure and the nexus areas in the context of a circular economy to improve resource efficiency. The Forum will focus on disruptive drivers that are at play, and how they can be used favourably to shape energy for sustainable development. The event will unite all technology options with regional cooperation, investment and financing aspects.

3. The intent is to agree on a balanced set of options for countries to pursue concretely and effectively in both the near term and the longer term and to inform key political processes about collective insights on energy for sustainable development. The event will consider the solutions proposed during the Energy Ministerial at the outset of the Eighth Forum held in Astana, Kazakhstan, on 11 June 2017, and enhance the collective recommendations as a further milestone in the international forum process.

A. The Forum

4. The International Forum on Energy for Sustainable Development is a platform that provides context and enables clear-sighted action. This Ninth Forum will combine an opening ministerial session with plenary sessions, parallel workshops and site visits over four days. Through a series of multi-stakeholder panels and discussions, the Forum will explore what energy for sustainable development means and how cooperation and concerted action could deliver the 2030 Agenda.

5. The importance of collaboration to achieve sustainability cannot be overstated. Partnerships and multi-stakeholder collaboration at scale at all levels are essential for achieving the 2030 Agenda. A collaboration among the United Nations system, governments, civil society, financial institutions, and the private sector is needed to leverage expertise and resources to address the complex and interlinked challenges of energy for sustainable development.

6. The Forum is organized jointly by the Government of Ukraine and the United Nations Regional Commissions in partnership with the United Nations Development Programme (UNDP), United Nations Institute for Training and Research (UNITAR), UN Environment, The World Bank, International Energy Agency (IEA), International Renewable Energy Agency (IRENA), International Atomic Energy Agency (IAEA), Global Environment Facility (GEF), Organization for Security and Cooperation in Europe (OSCE), International Energy Charter, International Energy Forum (IEF), and the Copenhagen Centre on Energy Efficiency, International Institute for Applied Systems Analysis (IIASA), Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT, Pacific Northwest National Laboratory (PNNL), Dartmouth College, and Climate Action Network (CAN). The Forum will attract international energy experts, government officials, and representatives from the business community, financial sector, academia and civil society to share perspectives on how sustainable energy systems can be designed and implemented. It will also include the annual sessions of the UNECE Groups of Experts on Energy Efficiency and on Renewable Energy. Among the planned parallel workshops are a regional workshop on Pathways to Sustainable Energy and the fourth meeting of the Joint Task Force on Energy Efficiency Standards in Buildings

7. In 2017, the five Regional Commissions worked with the World Bank and the International Energy Agency to assess the world's progress on sustainable energy. The conclusion was that the energy sector's support for the 2030 Agenda is at risk of faltering because the rate of improvement in energy efficiency, deployment of net low carbon energy solutions, and provision of sustainable access to modern energy services are insufficient. Accelerated and concrete measures are needed to improve energy productivity, rationalize energy use, optimize energy resources, and deploy sustainable energy technology and infrastructure. The Ninth Forum will feature an honest and rational conversation about key challenges including energy security, fossil fuel dependency, lack of information, and inadequate capabilities to effect change. Attaining the objectives of the 2030 Agenda will require full engagement of industry to transform energy. It is essential to monitor progress on energy for sustainable development in ways that reflect the cross-cutting interconnections among the Sustainable Development Goals (SDGs), at a minimum, linkages among SDG 6, 7, 11, 12, 13, 15, and 17.[2]

8. Certain options for improving the overall performance of today's energy system often are excluded for reasons of public perception and emotions, politics, imposed market distortions, or environmental and safety concerns. Truly transforming the energy system will require creative shifts in policy and regulation including treating energy as a series of services rather than as a series of commodities. In many countries, the current political, regulatory, and industrial infrastructure is not yet ready for such a transformation and countries are not yet alert to challenges that will emerge with the 2030 Agenda. Today's economic infrastructure is not ready to embrace the implications of the new normal.

9. The Ninth Forum will deliberate on emerging opportunities and concerns. The Forum proposes activities grouped in four parallel pillars:

(a) Energy transition and decarbonization;

(b) Robust energy systems and infrastructure resilience;

(c) Matchmaking and investor confidence;

(d) Hot topics and deep dives.

[2] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

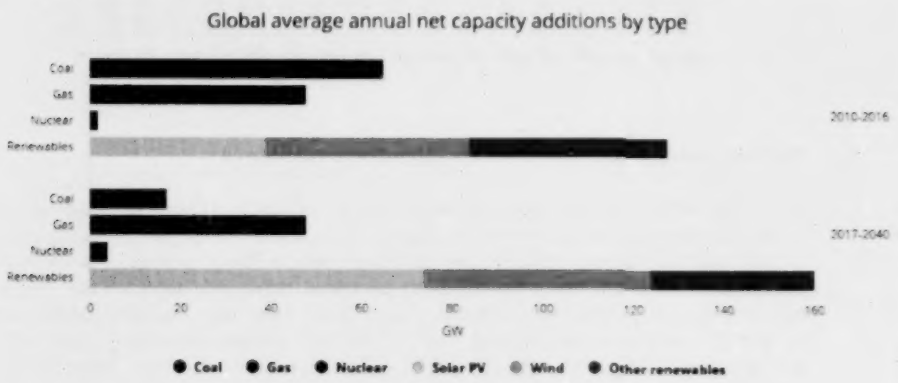
B. Energy transition and de-carbonization

10. The first pillar of the Ninth Forum will explore cost-effective decarbonization of energy. International cooperation can reinforce national actions and thereby accelerate transformation. The nexus among energy and other key development areas (e.g. water, air, food, health, education, and gender) suggests that opportunity lies in cross-sector perspectives and holistic decision-making.

11. The development and deployment of clean technologies and their interplay with existing infrastructure lie at the heart of options that are available to build the future energy system over the medium term, especially as 80% of today's energy is fossil-based. For instance, as of January 2018 more than 656 GW of new coal capacity has been in construction worldwide (but net additions from 2017 to 2040, i.e. considering the decommissioning, is expected only at the level of around 400 GW).

Figure I

Global average annual net capacity additions by type. Source: World Energy Outlook 2017, International Energy Agency



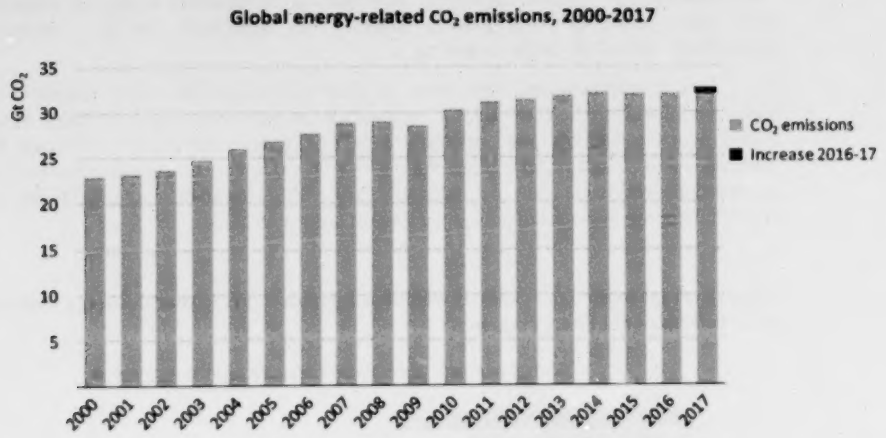
12. The number of people whose national incomes and livelihoods depend on fossil energy is important. As a consequence, the energy transition requires rapid but careful management – enhancing quality of life as the central objective obliges connected policy approaches that optimize across the entire 2030 Agenda, including notably decarbonization and climate, energy access, water and environment, and health.

13. The world's carbon intensity of energy has remained mainly flat over the past twenty years with minor increase in 2017.

14. Additions of renewable energy capacity have yet to deliver the needed and expected decarbonization. Recent studies show no correlation between additions of power from renewable energy sources and the overall net carbon intensity of energy. While "energy for sustainable development" is about more than just energy and climate, energy is the key sector for meeting climate objectives. However, action to reduce energy-related emissions is not currently included in about half of the nationally determined contributions (NDCs) submitted to UNFCCC. When such actions are included, they do not necessarily cover emissions from all sources of energy and it is not always clear that pledges in NDCs are consistent with existing national energy policies and plans.

Figure II

Global energy-related CO_2 emissions, 2000-2017. Source: Global Energy & CO_2 Status Report 2017, International Energy Agency



C. Robust energy systems and infrastructure resilience

15. This pillar will examine energy infrastructure, resilience and planning and proposes to provide a platform to explore various angles. The adequate integration of climate risks in the planning of climate sensitive investments requires a change in mindset away from conventional behaviour and practices to an integrated framework approach that brings together climate information, climate impact assessment and decision-making for investment. Such a paradigm shift requires credible climate information used with appropriate modelling tools and supported by dedicated institutions to better inform policy and development planning.

16. For example, the recent World Bank/UNECA study on "Enhancing the climate resilience of Africa's infrastructure" (ECRAI) showed that proper integration of climate change in the planning and design of infrastructure investments can reduce considerably the risk posed by the climate of the future to the physical and economic performance of hydropower and irrigation investments.[3] To sustain Africa's growth and accelerate the eradication of extreme poverty, investment in infrastructure is fundamental. The 2010 Africa Infrastructure Country Diagnostic found that investment of some US$ 93 billion per year for the next decade will need to be invested to enable Africa to fill its infrastructure gap. The Program for Infrastructure Development in Africa (PIDA), endorsed in 2012 by the continent's Heads of State and Government, lays out an ambitious long-term plan for closing Africa's infrastructure gap, including through major increases in hydroelectric power generation and water storage capacity. Much of this investment will support the construction of long-lived infrastructure (e.g. dams, power stations, irrigation canals, etc.) that may be vulnerable to changes in climatic patterns though the direction and magnitude of the climatic changes remain uncertain.

[3] https://openknowledge.worldbank.org/handle/10986/21875

17. The more profound the transition that is undertaken towards low-carbon energy and green economy, the more competitive and sustainable a country's economy will be in the future. For example, great potential lies in the transformation of large industrial complexes and modernizing energy infrastructure comprehensively. There are a number of industrial complexes around the world where mining, power generation, metallurgy, manufacturing and shipping facilities have been integrated into dense, interrelated businesses. Cities and populated areas have grown around these large industrial complexes with their employment opportunities, and they are now vulnerable to environmental impacts and social upheaval. When countries modernize their mining and energy sectors it is in their best interest do so sustainably. Cities and regions around the globe are key contributors with innovative solutions. When done in partnership and developed transparently and openly, modernization of large industrial complexes can lead to innovation-led, socially and environmentally responsible sustainable national energy strategies.

18. There is also a great challenge across the globe in renovating existing buildings, especially multi-apartment residential ones. Poor maintenance of these buildings in cities has resulted in poor energy performance and also led to social burdens, aging housing stock, common spaces in poor technical condition, safety hazards, and energy poverty. In many countries, multiple demonstration projects showcase modern technology for energy efficient renovation. However, many of the high-technology buildings do not sustain their performance over time as there is poor understanding of the required technical expertise. The human factor presents a huge challenge in organizing energy-efficient renovation of residential multi-apartment buildings in addition to the technological, managerial and financial challenges.

D. Matchmaking and investor confidence

19. The Ninth Forum represents a renewed opportunity for the financial and energy communities to network and explore partnerships in the wider context of the 2030 Agenda. Building on last year's demand, matchmaking activities are offered to facilitate a dialogue about possibilities for developing sustainable energy and promoting transformational investment and about lingering issues that might hamper investments. Participants have the opportunity to discuss key issues, identify priorities and propose concrete recommendations for policy changes needed to overcome political, legal, regulatory, technical barriers and take advantage of clean energy potential.

20. With respect to renewable energy, over the past decades most countries adopted detailed renewable energy strategies with ambitious goals and financial support mechanisms to facilitate investment. Global new investments in renewable power and fuels marked new records in 2017. However, these measures have not proven sufficient to foster renewable energy investment and deployment in all countries alike, and the level of investments on renewable energy projects is far from sufficient to reach the ambitious climate change and sustainable development goals. While the costs of renewable energy may be falling, the cost of integrating intermittent sources of energy into the grid is not. Therefore, the challenge goes beyond financing investments and involves approaching a sustainable energy mix from a broader angle and applying broad thinking to a net zero-carbon energy system.

21. However, it is not only the renewable energy community that is facing difficulties to access financing. It is equally challenging to operate to the highest standards in existing power plants with limited access to finance for modernization and grid integration. The Forum offers a platform to voice concerns about fossil fuel financing for those that attempt to provide populations with electricity access, grid stability and a diversified energy mix. Full transformation of the energy system requires alignment of investment incentives with

the objectives of the 2030 Agenda. The Forum will offer opportunities to improve confidence in transformational, long-term investments in energy for sustainable development as a whole. The workshops and activities proposed in this pillar are intended to support all actors participating in the energy development and deployment process.

E. Hot topics and deep dives

22. The approach taken for the first time in the forum process is a pillar designed for deeper dives into selected topics of interest. The topics at the Ninth Forum include the impact of digitalization, sustainable resource management, and other topics of unique impact to drive change.

23. Digitalization lies at the heart of change in modern society, how we live, travel, and do business. In modern economies, without a digital infrastructure there would be no energy production, distribution or use. Questions of security, dependency, privacy and disruption are arising as industrial players and utilities invest in digitalization in a major way. There is little information on the value digital technology provides to the energy industry. This deep dive will discuss where are the biggest pay-offs lie, which services are growing fastest, which technologies show the biggest promise, and how business models are evolving in response.

24. Few institutions have made resource productivity a priority. The global economy is increasingly characterized by greater resource scarcity and a desire to reduce waste. Adopting innovative approaches and taking the lead on resource productivity would strengthen competitiveness and improve economic robustness.

25. Improving energy efficiency in buildings is the single largest opportunity to save resources and address climate change, it also makes good business sense to develop improved building envelopes, insulation, more efficient heating and cooling systems and the like. The transition to sustainable energy consumption requires action on different scales, from installation of equipment in individual buildings to development of infrastructure on district, city and regional levels. Some energy solutions are complementary (e.g., a building can be equipped with different types of energy efficient equipment from lighting to heating, ventilation and air conditioning (HVAC) systems), while other solutions are alternative (e.g., a building can be heated by an individual heating system or connected to a district heating network). In practice, implementation of energy efficiency and renewable energy solutions involves a multitude of stakeholders, from energy consumers and installers to utilities, energy program administrators and government authorities. In this context, effective coordination between the stakeholders based on high quality data is an important success factor.

26. Many countries and cities have started to use big and geo-spatial data for the successful implementation of sustainable energy projects, e.g. for the estimation of the renewable energy potential on country level, the development of city energy infrastructure plans or the identification of energy saving potentials for individual energy consumers. Events around this topic will introduce participants to the underlying thought process and technology as well as facilitate an international experience exchange based on case studies, as the respective data management and analysis methods can be easily applied in different locations.

F. Ambition

27. The Ninth Forum provides a unique opportunity to build upon the achievements of previous fora and develop a roadmap for what participants would like to achieve in the short- and medium-term with regards to the 2030 Agenda.

28. Outcome documents from the previous two fora[4] called for a deep long-term transition to a sustainable energy future and set out concrete steps the United Nations Regional Commissions and their member States could take. The actions were discussed at the Eighth International Forum on Energy for Sustainable Development and Energy Ministerial and were endorsed by participating ministers:

- Accelerating the transition to a sustainable energy system;
- Improving energy efficiency in buildings;
- Improving energy efficiency in industry;
- Accelerating the uptake of renewables;
- Understanding the role of natural gas;
- Valuing coal mine methane;
- Extending deployment of United Nations Framework Classification for Resources;
- Reducing the environmental footprint of fossil energy through deployment of high efficiency, low emissions technology and carbon capture use and storage;
- Building on international cooperation and collaboration; and
- Improving data quality and indicators.

29. The Ninth Forum and its energy ministerial will provide a reality check on the real state of the energy transition through an honest and informed debate on the need to modernize fossil-based economies and the drive towards a green economy.

30. Such a system notably would address all aspects of sustainable development in line with national priorities and concerns, including climate change and natural resource use, job creation and energy security, social tolerance, health and energy access, among others. All nations are committed and are in the process of developing or implementing their approach to achieving their interpretation of sustainable energy and the 2030 Agenda. It is necessary that each country recognizes the perspectives and the drivers of the others, that there is not a single approach to the transition but a multitude of approaches. What truly matters is that the collective outcome delivers the needed results and that this collective approach can achieve these targets faster than individual national or sectoral actions.

[4] See:
http://www.unece.org/fileadmin/DAM/energy/se/pdfs/eneff/7th_Forum_Baku_Oct.2016/Joint_Statement_IFESD.5_2014.pdf
andhttp://www.unece.org/fileadmin/DAM/energy/se/pdfs/eneff/7th_Forum_Baku_Oct.2016/Statement_of_CommonAction_IFESD.6_2015.pdf

Annex II

Outcome Document of the Ninth International Forum on Energy for Sustainable Development (Draft for consideration)

I. Key Messages

1. The vital role that energy plays as an enabler for improving quality of life must be recognized, and its links to other sectors such as water, climate, health, and agriculture must be strengthened through integrative policies. Without energy, attainment of the 2030 Agenda for Sustainable Development is at risk.

2. Coherent policies and enabling environments must be in place to mobilize necessary investments, and best practices and experiences should be shared and promoted. The current political, regulatory, and industrial infrastructure is not ready for deep transformation.

3. 80% of today's energy mix is fossil-based, and fossil energy will remain important, a reality that makes it imperative to address the environmental footprint of fossil fuels immediately.

A. Recommendations for priority action:

4. Some options for addressing energy for sustainable development are sensible economically, environmentally, and socially under all circumstances and should be pursued aggressively and diligently. These include sustainable resource management, energy efficiency improvements in buildings, industry, and transport and methane management in the extractive industries.

5. Energy prices must reflect full costs, including externalities, to enable sustainable management of energy resources and accelerated uptake of energy efficiency and clean energy technology. Energy subsidies must be rationalised to remove market distortions while protecting vulnerable groups and should be focused on overcoming short-term obstacles.

6. Reductions in the costs of renewables present an opportunity to meet energy demand with renewable energy sources:

(a) For Latin America and the Caribbean region, it is important to mainstream renewables in policies, programmes and projects to improve energy access, particularly in rural areas, and to attract investment. Governments can support renewables by reducing risks, extending fiscal and non-fiscal incentives, and providing more conducive legal frameworks and regulatory stability;

(b) For Africa and the Arab region, the promotion of local content enhancement across the full renewable energy value chain can catalyse longer term enhanced deployment of renewables with wider socio-economic benefits.

7. It is important to ensure that climate resilience is fully integrated into planning energy infrastructure and investments that are at risk from climate change and variability. Investment in power grids and promotion of cross-border interconnections will accelerate access to electricity, improve efficiency, and accelerate penetration of variable renewable power

8. Improving the performance of the transport sector, incorporating cleaner and more efficient technologies, multi-modality and greater use of renewable energies is of high importance.

9. For Asia and the Pacific region, clean cooking must be better integrated into energy policy frameworks. In Africa region and in Latin America and the Caribbean region, the gradual replacement of traditional biomass fuels for cooking and heating with modern energy sources should be promoted. New employment opportunities for women are also important: with greater economic value attributed to women's time, households are more likely to choose more efficient technologies with reduced fuel gathering requirements.

10. The United Nations Economic Commission for Europe (ECE) is exploring alternative pathways countries might consider achieving their national targets while contributing to global and regional objectives. The project is an important vehicle for understanding the gaps that exist in meeting the energy-related objectives of the 2030 Agenda and the opportunities available to close the gaps. The other regional commissions might consider undertaking similar assessments and interested agencies might join the process.

11. In every region there is a need for human and institutional capacity for energy planning and management and greater engagement with the private sector, transparency and accountability, monitoring and data collection systems, dissemination and information-sharing between institutions and a stronger role for science and research. Efforts to encourage innovation in energy services and promote collaborative research and development at the regional level should be planned and introduced.

12. The SDG 7 indicators/targets reflect a limited view of energy's contribution. Indicators with explicit links to other sectors and SDGs need to be developed to track movement towards the desired target – a low-carbon energy system that provides affordable access to sustainable energy services for all. Data sources and data gathering/analytical capacity of countries do not meet requirements. The tracking reports of the regional commissions in collaboration with the World Bank and the IEA have highlighted the shortcomings. The reports provide important information for policy makers. The reports should be updated regularly on a three-year cycle. Data gaps and reliability should be addressed to inform investment planning, develop greater capacity to collect and analyse energy data, harmonize data-collection methodologies and strengthen existing data-collection systems.

13. Development and implementation of suitable policies and institutional frameworks to manage natural resources more sustainably, boost energy efficiency measures and practices, and address barriers preventing progress in energy efficiency and renewable energy deployment is inevitable.

B. Africa is unlikely to achieve SDG 7 by 2030

14. While countries in North Africa have attained nearly universal access to electricity and clean cooking and some countries in the rest of Africa are progressing towards universal access by 2030, most of the continent is unlikely to achieve SDG 7 with existing policies and commitments.

15. *Access:* Due to future projected population growth (from 1.3 billion people in 2017 to 1.7 billion in 2030), roughly the same number of people are likely to be without access to electricity in 2030 as in 2016 (590 million). The number of people without access to clean cooking fuels will reach 900 million by 2030.

16. *Efficiency:* Energy intensity remains high (6.0 MJ/USD in 2014), largely as a result of overreliance on inefficient biomass and weak energy efficiency policies and programmes.

17. *Renewable Energy:* Renewable electricity capacity exceeded 38 GW in 2016 (about 23 percent of the total), driven mainly by developments in wind, solar PV, geothermal and large hydropower. However, the region has ambitious targets that will require substantial political will and innovative and ambitious policies, including an enabling environment for mobilizing private sector finance from foreign direct investment and domestic resources.

C. For Latin America and the Caribbean region SDG7 is unachievable

18. *Access:* The number of people without access to electricity fell from 44 million in 2000 to 18 million in 2014. If current growth rates are maintained and if additional resources are provided for the countries with the largest deficits, 100% access could be attained by 2030. Access to modern energy sources for cooking has been improving, but over 84 million people still lacked access as of 2014. Annual rates of expansion have declined in recent years, and at current rates of progress (roughly 0.5 percent per year) the SDG 7 target will not be achieved.

19. *Electricity:* The region is the least energy intensive in the world. However, it also has the lowest annual rates of improvement (approximately 0.5 percent per year on average between 1990 and 2010). Although the energy intensity indicator has been trending down, driven mainly by efficiency gains in the industrial sector, at the current pace of progress it will be impossible to achieve the target set for 2030.

20. *Renewable Energy:* Renewable energy sources are used widely in the region, with modern renewable energies representing 22.9 percent of TFC in 2014. There has been a slight downward trend in both indicators, which could be reversed with more non-conventional renewable energy and hydropower plants and stronger policies for sustainable use of firewood.

D. Asia and the Pacific region is moving forward but unlikely to achieve SDG7

21. *Access:* Although the region made remarkable progress on electricity access in the last decade almost 10 percent of the region's population still have no access to electricity. The region is on track to reach nearly universal access to electricity by 2030, however there are some countries with acutely low access rates. Almost half of the population rely on polluting and unhealthy cooking fuels and technology, therefore the region is far from being on track to achieve universal access to clean cooking by 2030.

22. *Efficiency:* The region has demonstrated a long-term steep decline in energy intensity, falling from 9.1 MJ/2011 USD (PPP) in 1990 to 6.0 MJ/2011 USD (PPP) in 2014, and progressing towards convergence with the 2014 global average of 5.4 MJ/ USD (PPP).

23. *Renewable Energy:* The share of renewable energy, including both traditional and modern forms, reached 18.3 percent of the region's TFC in 2014, down from 23 percent in 1990, though up from a low of 17.9 percent in 2011. Modern renewables comprised 6.8 percent of TFC in 2014, up from 6.2 percent in 2012. In absolute terms, renewable energy consumption increased from 29.3 EJ in 2012 to 31.1 EJ in 2014.

E. Progress in the ECE region is falling short

24. Attainment of SDG 7 is falling short in the ECE region, except for the target on 100% access to electricity, and if "access" is defined more broadly, challenges remain on access to heating services and on reliability, affordability and quality of service. The region has specific climatic, economic, environmental and political circumstances leading in parts of the region to inefficient use of energy, power cuts, increasing energy costs, and unsustainable and unaffordable heating in winter. ECE falls short as well on the other energy-related SDGs that support improving quality of life. On current trends, energy will not deliver needed support to the 2030 Agenda, notably in the area of climate.

25. *Access:* ECE officially has achieved 100% access to power networks and 98% access to clean cooking fuels, but there are significant quality and affordability challenges. Access to distributed generation sources or to alternative energy networks must be considered.

26. *Efficiency:* The rate of progress in improving energy intensity is insufficient to meet the 2030 goal. Improvements in energy intensity in the region recently have been around -2 percent per annum since 2012.

27. *Renewable Energy:* Annual renewable energy investments in the region need to more than double to achieve the 2030 target. The ECE region has an increasing share of renewable energy in total final consumption (TFC) but certain sub-regions have low and declining investment rates in renewable energy.

F. Arab region overall progress is challenged

28. *Access:* Overall, access to electricity is close to universal in cities across the Arab region but remains fixed at approximately 80 percent in rural areas, with a total of around 36 million people lacking access to electricity in 2014. Planned and unplanned service disruptions in many countries in the region are a challenge for electricity users, irrespective of the urban–rural divide or income disparities. In some areas, war, regional instability and mass migration also present significant challenges in providing energy access to millions of people. The share of the population using clean cooking fuels and technologies has risen continuously since the 2000s, and stood at 88 percent in 2014, with intra-regional differences.

29. *Electricity:* While the Arab region has historically not been one of the most energy-intensive regions in the world, it has been the only one to have no reduction in its energy intensity over the past 25 years, while energy consumption has more than doubled since 1990. Residential and service sectors combined accounted for at least two-thirds of total annual electricity consumption in the region, of which around 73 percent was consumed by the residential sector alone. A recent study by the World Bank estimated the potential savings from energy efficiency at 21 percent of projected total primary energy supply (TPES) in the Middle East and North African countries by 2025.

30. *Renewable Energy:* Despite a considerable potential for use of modern renewable energy technologies, such as wind and solar power, renewable energy still plays a marginal role in most Arab countries, at 4 percent of TFC in 2014, including biomass. Its overall low contribution to the energy mix reflects the region's globally unparalleled reliance on non-renewable sources.

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Committee on Sustainable Energy

Twenty-seventh session
Geneva, 26-27 September 2018
Item 4(b) of the provisional agenda
The role of the Committee on Sustainable Energy and its subsidiary bodies in Supporting the 2030 Agenda on Sustainable Development: Sustainable resource management

Bridging Document between the National Standard of the People's Republic of China Classification for Petroleum Resources/Reserves (GB/T 19492-2004) and the United Nations Framework Classification for Resources

Prepared by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification[1]

Summary

This document provides the Bridging Document between the National Standard of the People's Republic of China Classification for Petroleum Resources/Reserves (GB/T 19492-2004) and the United Nations Framework Classification for Resources (UNFC). Bridging documents explain the relationship between UNFC and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical

[1] This Bridging Document was developed by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification. Following review by the Expert Group at its eighth session, 24–28 April 2017, the Bridging Document was issued for public comment from 15 February to 15 April 2018. Development of this Bridging Document has followed the Document Approval Procedure agreed by the Expert Group at its fifth session, April 2014. The Bridging Document is presented to the Committee on Sustainable Energy at its twenty-seventh session for endorsement.

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Code". This Bridging Document compares reserves and resources by Categories of GB/T 19492-2004 to Categories and Classes of UNFC. GB/T 19492-2004 was issued by the Standardization Administration of the People's Republic of China under the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 30 April 2004, and implemented on 1 October 2004. It establishes unified guidance regarding China's principles for evaluation, auditing and reporting of reserves and resources of crude oil, natural gas and gas condensate. This Bridging Document does not affect the independent application of GB/T 19492-2004 and application of GB/T 19492-2004 does not affect any component of UNFC. In the event of any difference between the Chinese language version and any other language version, the Chinese language version shall prevail.

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I. Introduction

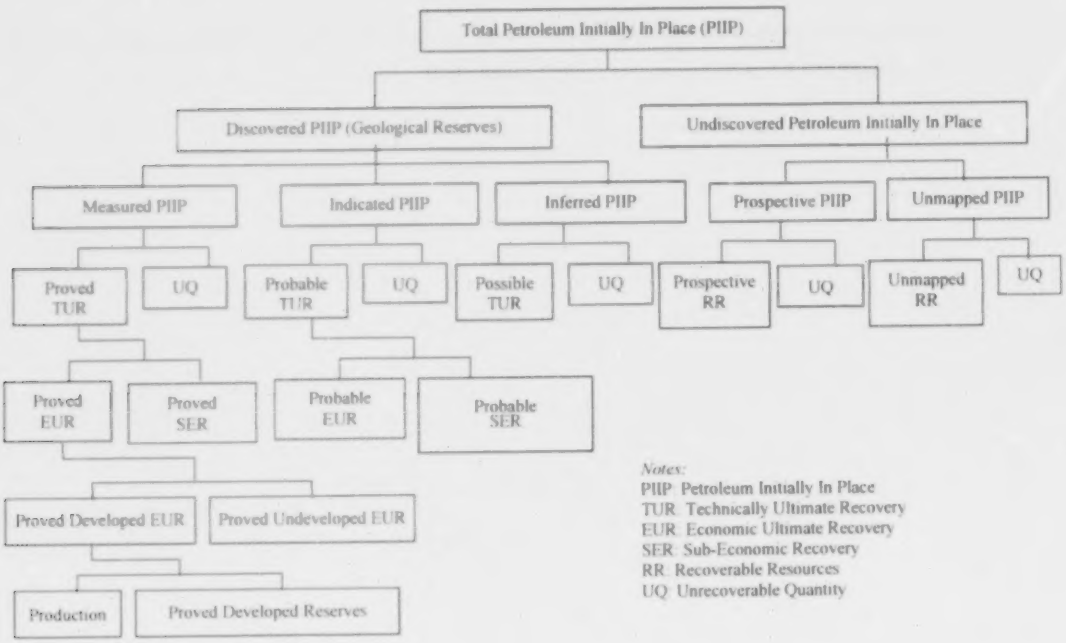
1. Bridging Documents explain the relationship between the United Nations Framework Classification for Resources (hereinafter referred to as "UNFC") and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical Codes. The relevant Bridging Document shall be identified when reporting estimates using the UNFC Numerical Codes.

2. This document compares reserves and resources by categories of the National Standard of the People's Republic of China "Classification for Petroleum Resources/Reserves" (GB/T 19492-2004) (hereinafter referred to as "GB/T 19492-2004") with Categories and Classes of UNFC.

3. GB/T 19492-2004 was issued by the Standardization Administration of the People's Republic of China under the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 30 April 2004, and implemented on 1 October 2004. It establishes unified guidance regarding China's principles for evaluation, auditing and reporting of reserves and resources of crude oil, natural gas and gas condensate (Figure 1).

4- GB/T 19492-2004, the enforced guidelines for the reporting of oil and gas reserves to the Chinese Government, is independent of UNFC. This Bridging Document does not affect the independent application of GB/T 19492-2004. The application of GB/T 19492-2004 does not affect any component of UNFC.

Figure 1
Chinese Classification for Petroleum Resources/Reserves



5. In GB/T 19492-2004, the classification is mainly based on exploration and development phases, geological knowledge and confirmation of productivity. The classification of volumes according to GB/T 19492-2004 is divided into different classes and categories according to the vertical and horizontal axes.

6. The horizontal axis is divided into two major classes according to the status of discovery: Reserves (discovered) and Resources (undiscovered). According to the status of the asset and the geological reliability, the Geological Reserves are sub-divided further into three categories: Inferred, Indicated and Measured; Resources is sub-divided further into two categories: Prospective and Unmapped. The vertical axis is divided into four classes, based on the resources attributes: PIIP (Petroleum Initially In Place), TUR (Technically Ultimate Recovery), EUR (Economic Ultimate Recovery) and Development Status.

A. The Vertical Axis: covers four classes from top to bottom

7. First class: Volumes in place. PIIP is an abbreviation of Petroleum Initially In Place. Total Petroleum Initially In Place (PIIP) refers to the total oil and gas quantities existing initially in discovered and undiscovered accumulations which are estimated by using appropriate methods, based on the geological, geophysical and laboratory data available in different exploration and development phases.

8. Second class: Technical recoverability. TUR is an abbreviation for Technically Ultimate Recovery. These are the volumes that can technically be recovered from the reservoir, regardless of other constraints or economic criteria. Unrecoverable Quantities are abbreviated to UQ. The summation of TUR and UQ will provide the PIIP. For prospective and unmapped resources, RR replaces TUR, and it is an abbreviation for Recoverable Resources.

9. Third class: Economic viability. EUR is an abbreviation of Economic Ultimate Recovery and refers to those quantities of petroleum which are estimated, on a given date, to be economically recoverable from an accumulation, plus the quantities already produced. SER, an abbreviation of Sub-Economic Recovery, refers to the technically ultimate recovery that is determined to be sub-economic in economic evaluation, or cannot be classified as EUR with consideration to contract, enhanced recovery technology or other factors. The sum of EUR and SER will provide the TUR. Economic viability is only considered in the case when the volumes are categorized as Indicated or Measured (see paragraph 19).

10. Fourth class: Development status. For an approved project, this level provides the detailed development status of all volumes. The sum of Cumulative production, Proved Developed Reserves and Proved Undeveloped EUR is equal to the Proved EUR, maintaining the balance in the whole system. Development status is only estimated for the volumes categorized as Proved EUR (see paragraph 20).

B. The Horizontal Axis: from right to left

11. In GB/T 19492-2004, the classification focuses more on geological knowledge and technical recoverability than on economic viability. As the type of project is related to the exploration and development phases, the classification and categorization of Geological Reserves (also known as Discovered PIIP) and TUR are considered important.

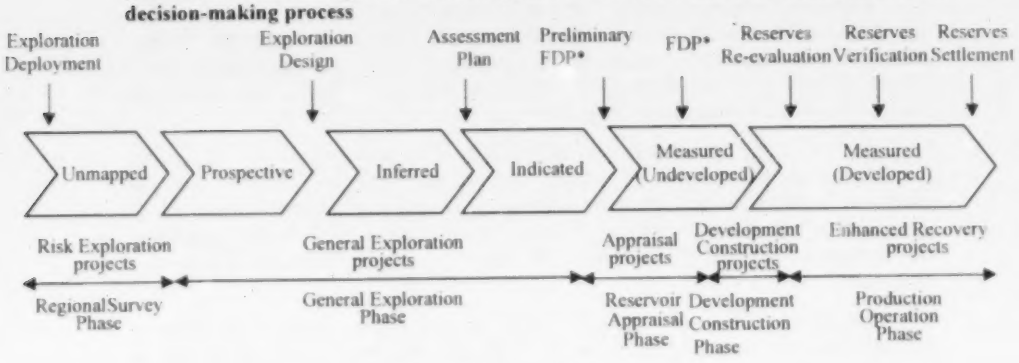
12. GB/T 19492-2004 emphasizes the overall assessment status of petroleum reservoirs. Before the discovery, the volumes are classified under the Undiscovered PIIP class. After discovery, they will be classified under Discovered PIIP (or Geological Reserves). The Discovered volumes are also classified based on the project status and the level of geological

knowledge associated with the petroleum reservoir. The Geological Reserves associated with the asset are assigned to one of three categories: Inferred, Indicated or Measured. These categories reflect the degree of geological confidence from low, moderate and high for the same reservoir in different stages of exploration and development, respectively (**Error! Reference source not found.** Figure 2):

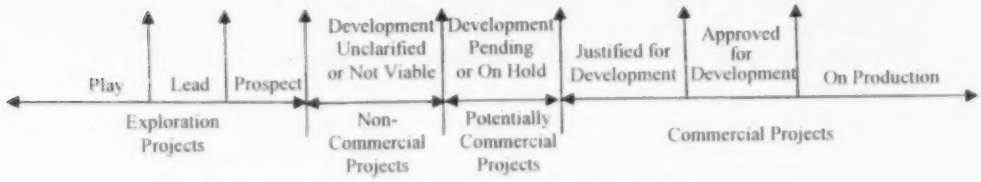
- After discovery: low geological confidence. Volumes are categorized as "Inferred". No economic evaluation is completed yet.
- During the General Exploration phase: moderate geological confidence. Volumes are categorized as "Indicated". Preliminary economic evaluations are completed.
- After the Reservoir Appraisal phase: high geological confidence. Volumes are categorized as "Measured". Detailed economic evaluations are completed.

Figure 2

Classification and Categorization correspond to the Exploration and Development phases and the decision-making process



Above: GB/T 19492-2004
Below: UNFC



Note: * FDP – Field Development Plan

C. In Place Volumes

13. Undiscovered PIIP: refers to the total quantities of oil and gas estimated in unknown accumulations based on predictions. It can be categorized as Prospective PIIP and Unmapped PIIP.

- Prospective PIIP: refers to the Total Petroleum Initially In Place in known and confirmed favourable traps or blocks (formations) adjacent to oil and/or gas reservoirs estimated by the trap method at the early stage of the General Exploration phase, through analysis and analogy of petroleum geological conditions.

- Unmapped PIIP: refers to the Petroleum Initially In Place in the prospecting basin, depression, sag, belt and other accumulations, which is estimated in the Regional Survey phase or other exploration phases, based on geological, geophysical and geochemical surveys, and regional exploratory well data. It is generally the Total Petroleum Initially In Place minus the Prospective PIIP and minus the Geological Reserves.

14. Geological Reserves (Discovered PIIP): refers to the total oil and gas quantities estimated based on seismic, drilling, well logging and test data in known reservoirs/fields after oil and gas are found by drilling. It can be categorized as Inferred PIIP, Indicated PIIP and Measured PIIP based on project status and geological knowledge (see Figure 2).

- Inferred PIIP: refers to the Geological Reserves that are estimated during the General Exploration Phase with a low level of confidence when oil and/or gas flows are obtained from a wildcat well, or the integrated interpretation indicates the probable existence of oil and/or gas layers. Further exploration will be required. The Inferred PIIP is estimated under the preconditions that: (1) the structural configurations and reservoir conditions should be preliminarily ascertained; and (2) a wildcat has obtained oil and/or gas flows or encountered oil and/or gas layers, or the reservoir/field is immediately adjacent to Measured (or Indicated) oil and/or gas zones, which show further exploration potential through comprehensive analysis.

- Indicated PIIP: refers to the Geological Reserves that are estimated with a moderate level of confidence and relative error not more than ±50% after commercial oil or gas flows are obtained from a prospecting well during the General Exploration Phase. The volumes will be categorized as Indicated PIIP under the conditions that: (1) Preliminary studies have provided information about the structural configuration, reservoir formation continuity, oil and gas distribution, reservoir type, fluid properties and productivities, etc.; (2) the level of geological confidence is moderate; and (3) it can be used as evidence for drilling reservoir appraisal wells and making conceptual design or development plans.

- Measured PIIP: refers to the Geological Reserves that have been proved economically recoverable by appraisal drilling during the Reservoir Appraisal phase. The volumes are estimated with a high level of confidence and relative error, not more than ±20%. The volumes will be categorized as Measured PIIP if: (1) the reservoir type, depositional environment, drive mechanism, fluid properties and distributions, and productivities etc. are known; (2) fluid contacts or the lowest known hydrocarbons are determined by drilling, logging and testing data or reliable pressure data; (3) reasonable well control or primary development well pattern designed in a development plan is available; and (4) all parameters have a high level of certainty. If the conditions above are met, a Final Investment Decision is expected for the development of the asset and proved EUR can be estimated.

D. Technical Recoverability

15. In the GB/T 19492-2004, "Measured" "Indicated" and "Inferred" are categories of PIIP within a reservoir based on geological confidence in a different phase. "Proved", "Probable" and "Possible" refer to the recoverable portions of Measured, Indicated and Inferred respectively. It should be noted that this terminology is NOT linked to the meanings given for "Proved", "Probable" and Possible" contained in guidelines such as the Canadian Oil and Gas Evaluation Handbook (COGEH), the Petroleum Resources Management System

(PRMS), and those provided by the United States Securities and Exchange Commission (SEC).

16. Recoverable Resources (RR): refers to the recoverable oil and gas quantities from the Undiscovered PIIP. It can be categorized as Prospective RR and Unmapped RR, for which the recovery factors are estimated by the empirical analogy method.

- Prospective RR: refers to the recoverable oil and gas quantities from the Prospective PIIP.
- Unmapped RR: refers to the recoverable oil and gas quantities from the Unmapped PIIP.

17. Technically Ultimate Recoveries (TUR) are those volumes of petroleum which are estimated theoretically or by the use of analogues to be recoverable from discovered accumulations under given technological condition.

- Possible TUR: refers to the Technically Ultimate Recovery associated with Inferred PIIP, and meeting the following requirements: (1) All requirements and maturity for the Inferred PIIP have been met; (2) The applicable technology is likely to be implemented; (3) There should be at least 10% probability that the quantities actually to be recovered in the future will equal or exceed the estimated TUR.
- Probable TUR: refers to the Technically Ultimate Recovery associated with Indicated PIIP, meeting the following requirements: (1) All requirements and maturity for the Indicated PIIP have been met; (2) The applicable technology is presumed to be probably implemented; (3) The feasibility studies show the development is above sub-economic.
- Proved TUR: refers to the Technically Ultimate Recovery associated with Measured PIIP, meeting the following requirements: (1) All requirements and maturity for the Measured PIIP have been met; (2) The technology (including oil and/or gas production technology and enhanced recovery technology) has been demonstrated by pilot projects, or the recovery technology has been used successfully in analogous reservoirs; (3) The conceptual design or development plan is available, and the development has been implemented or will be implemented in the near future; (4) The feasibility study has been carried out based on recent average prices and costs.

18. Unrecoverable Quantities (UQ): refers to the difference between the PIIP and the Recoverable Quantity (RQ). In GB/T 19492-2004, the UQ can be divided into five categories, corresponding to the Unmapped, Prospective, Inferred, Indicated and Measured categories respectively.

E. Economic Ultimate Recoveries (EUR)

19. Economic Ultimate Recoveries (EUR): are those quantities of petroleum which are anticipated to be economically recoverable from discovered accumulations under existing economic conditions (such as prices, costs, etc.) or economic conditions defined by relevant contract, and under current executed or planned to be established technical operating conditions. They are divided into four categories: Probable EUR, Probable SER, Proved EUR and Proved SER.

- Probable EUR: refers to the economic ultimate recovery, associated with Indicated PIIP, meeting the following requirements: (1) All requirements and maturity for the Indicated PIIP have been met; (2) The preliminary feasibility studies show the

development is economic; (3) There should be at least 50% probability that the quantities recovered in the future will equal or exceed the estimated EUR.

- Probable SER: refers to the difference between the Probable TUR and the Probable EUR.

- Proved EUR: refers to the economic ultimate recovery, associated with Measured PIIP, meeting the following requirements: (1) All requirements and maturity for the Measured PIIP have been met; (2) The applicable technology has been implemented, or the applicable technology has been demonstrated by pilot projects and is virtually certain to be implemented, or the applicable technology has been applied successfully in analogous reservoirs in the same field and is virtually certain to be implemented; (3) Development plan is available, and it will be carried out in the near future; (4) Export facilities are or will be made available. For gas, there should be an existing gas pipeline or gas pipeline construction agreement, as well as a sales contract or agreement; (5) The reserve boundaries are based on the fluid contacts confirmed by drilling or reliable pressure test data, or the lowest known hydrocarbons encountered in the well, and within the boundaries of reasonable well control; (6) The economic productivity has been demonstrated by the actual production or by conclusive test, or the productivity in the formation is confirmed by analogy with offset wells or a similar formation in the same well which has indicated economic production; (7) Feasibility studies show the development is economic based on prices and costs stipulated in the contracts or agreements and relevant economic conditions; and (8) There should be at least 80% probability that the quantities actually recovered in the future will equal or exceed the estimated EUR.

- Proved SER: refers to the difference between the Proved TUR and the Proved EUR, and includes two parts: (1) Those Proved TUR for which the feasibility studies indicate the development is sub-economic; (2) Those Proved TUR that are anticipated to be economic, but for which uncertainties in contractual and/or enhanced recovery technologies preclude such volumes being categorized as Proved EUR.

F. Development Status

20. Proved EUR is further divided into Proved Developed EUR and Proved Undeveloped EUR. Proved Developed Reserves is the difference between the Proved Developed EUR minus the Cumulative Production.

- Proved Developed EUR: refers to the Recoverable Reserves that have been put into development after the completion of well drilling and the installation of associated facilities based on an approved oil and/or gas reservoir development plan. In the case of enhanced recovery technology (e.g. water flooding), the volumes are also categorized as Proved Developed EUR when the facilities required have been completed and put into services. The Proved Developed EUR should be updated regularly during the development and production.

- Proved Undeveloped EUR: refers to the economic ultimate recovery in the oil and/or gas reservoirs/fields where the reservoir appraisal has been completed, or a production pilot has been conducted, but the development wells have not been drilled yet.

21. To estimate Recoverable Reserves with GB/T 19492-2004, TUR is calculated first, and then economic evaluation is conducted with respect to Proved TUR and/or Probable TUR to distinguish EUR and SER. Economic evaluation is not made for Possible TUR. The economic evaluation may demonstrate two cases as follows:

- If the reservoir development project is economic, the SER equals the TUR minus the EUR;
- If the reservoir development project is sub-economic, the SER equals the TUR.

II. Direct mapping of Categories and Sub-categories

A. Application of the G Axis (confidence in the geological knowledge and potential recoverability of the quantities)

22. In UNFC, the recoverable quantities and additional quantities in place within known (discovered) deposits are categorized into high, moderate and low levels of confidence, represented by G1, G2 and G3 respectively. The estimated quantities associated with deposits yet to be discovered (project in exploration stage) are categorized as G4.

23. In GB/T 19492-2004, the Geological Reserves are mainly estimated by the deterministic volumetric method, with the reservoir as the basic unit. Reserves are divided into three categories, i.e. Inferred, Indicated and Measured, in an ascending order of the overall status of reservoirs in the exploration and development phases and the geological knowledge (see Figure 2). In GB/T 19492-2004, each reservoir has an independent category of geological reserves, directly associated with its own TUR and EUR. The Measured category includes Measured PIIP, Proved TUR, Proved EUR, Proved SER and Measured UQ, all of which have a high level of confidence (G1). The Indicated category includes Indicated PIIP, Probable TUR, Probable EUR, Probable SER and Indicated UQ, all of which have a moderate level of confidence (G1+G2). The Inferred category includes Inferred PIIP, Possible TUR and Inferred UQ, all of which have a low level of confidence (G1+G2+G3). There is no category of initially in place volumes and TUR in UNFC. For completeness of GB/T 19492-2004, categories and classes of PIIP and recoverable quantities are shown in Figure 3.

24. With regard to Exploration Projects, while UNFC provides the option to sub-categorize G4.1, G4.2, and G4.3 based on geological uncertainty, under GB/T 19492-2004 these categories refer to G4 without sub-categorization; when used alone, it reflects the best estimate.

Figure 3

Comparison of GB/T 19492-2004 and UNFC on the Confidence in Geological Knowledge and Potential Recoverability of the Quantities

<table>
<tr><td colspan="7">GB/T 19492-2004 Class/Category</td><td>UNFC Category</td></tr>
<tr><td rowspan="8">Discovered</td><td rowspan="4">Measured</td><td rowspan="4">PIIP</td><td rowspan="4">Proved TUR</td><td rowspan="2">Proved EUR</td><td>Proved Developed EUR</td><td>Cumulative Production</td><td>Extracted Production</td></tr>
<tr><td>Proved Developed EUR</td><td>Proved Developed Reserves</td><td rowspan="3">G1</td></tr>
<tr><td colspan="2">Proved Underdeveloped EUR</td></tr>
<tr><td colspan="3">Proved SER</td></tr>
<tr><td rowspan="3">Indicated</td><td rowspan="3">PIIP</td><td rowspan="3">Probable TUR</td><td colspan="3">UQ</td></tr>
<tr><td colspan="3">Probable EUR</td><td rowspan="2">G1+G2</td></tr>
<tr><td colspan="3">Probable SER</td></tr>
<tr><td>Inferred</td><td>PIIP</td><td colspan="4">UQ</td><td rowspan="2">G1+G2+G3</td></tr>
<tr><td rowspan="4">Undiscovered</td><td rowspan="2">Prospective</td><td rowspan="2">PIIP</td><td colspan="4">Possible TUR</td></tr>
<tr><td colspan="4">UQ</td></tr>
<tr><td rowspan="2">Unmapped</td><td rowspan="2">PIIP</td><td colspan="4">RR</td><td rowspan="2">G4</td></tr>
<tr><td colspan="4">UQ</td></tr>
</table>

B. Detailed mapping of the E and F Axes

25. While the G Axis (confidence in the geological knowledge and potential recoverability of the quantities) expresses the uncertainty and the confidence levels within each reservoir, the detailed matrix used for the mapping of the E Axis (economic and social viability of the project) and the F Axis (field project status and its feasibility) can be seen in Figure 4. The keys and colour code are provided in Figure 5.

Figure 4
Mapping of the E-F Matrix to GB/T 19492-2004 Classes and Categories

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3.1	F3.2	F3.3	F4
E1.1			3	4						
E1.2			3							
E2	4	4	4	4	5					
E3.1	12	12	12	12	12	12				
E3.2								9	10	
E3.3										11

Figure 5
Mapping of the E-F Matrix to GB/T 19492-2004. Code and Numeric Key

Class	*Sub-class*	*Code*	*GB/T 19492-2004 Class and Category*
Commercial Projects	On Production		Proved Developed Reserves
	Approved for Development	2	Proved Undeveloped EUR
	Justified for Development	3	Proved Undeveloped EUR
Potentially Commercial Projects	Development Pending	4	Proved SER, Probable EUR, Probable SER, Possible TUR
	Development on Hold	5	Proved SER, Probable EUR, Probable SER, Possible TUR
Non-Commercial Projects	Development Unclarified		Proved SER, Probable SER, Possible TUR
	Development Not Viable		Proved SER, Probable SER, Possible TUR
Additional Quantities in Place		11	Measured, Indicated and Inferred UQs
Exploration Projects	Prospect		Prospective RR
	Lead	9	
	Play	10	Unmapped RR
Additional Quantities in Place		11	Prospective and Unmapped UQs
Produced Not Sold		12	

26. The simplified version shown in **Error! Reference source not found.** shows the mapping without optional sub-classes. Note that the E and F Categories set the "minimum" standards for UNFC classes. For example, a Potentially Commercial Project must be at least E2 and F2, but it could also be E2F1.

Figure 6
Mapping Classes and Categories between GB/T 19492-2004 and UNFC

GB/T 19492-2004 Category / Class		*UNFC "minimum" Category*			*UNFC Class*
Discovered	Proved Developed Reserves, Proved Undeveloped EUR	G1	E1	F1	Commercial Projects
	Proved SER	G1	E2	F2	Potentially Commercial Projects
	Probable EUR, Probable SER	G1+G2			
	Possible TUR	G1+G2+G3			
	Proved SER	G1	E3	F2	Non-Commercial Projects
	Probable SER	G1+G2			
	Possible TUR	G1+G2+G3			
	UQ (Measured)	G1	E3	F4	Additional Quantities in Place
	UQ (Indicated)	G1+G2			
	UQ (Inferred)	G1+G2+G3			
Undiscovered	Prospective RR, Unmapped RR	G4	E3	F3	Exploration Projects
	UQ (Prospective, Unmapped)	G4	E3	F4	Additional Quantities in Place

C. Exploration projects

27. In **Error! Reference source not found.**, four cells (8, 9, 10 and 11) in the E-F matrix show the mapping of undiscovered quantities in GB/T 19492-2004. The categories are associated with exploration projects at different stages of maturity. In UNFC, the G4 category is used for the Exploration Projects. While UNFC provides the option to expand G4 to account for uncertainty in recoverable quantities (G4.1, G4.2 and G4.3), GB/T 19492-2004 does not provide an uncertainty range, and only the best estimate is provided.

D. Additional Quantities in Place

28. Additional Quantities in Place under UNFC correspond to quantities of hydrocarbons that are currently assessed as technically un-recoverable for any class in GB/T 19492-2004. In UNFC, these volumes are classified as E3.3 F4.

III. Mapping GB/T 19492-2004 Categories to Multiple UNFC Sub-categories

29. As UNFC contains more granularity than GB/T 19492-2004, it is expected that there will be instances where a single GB/T 19492-2004 category could reflect a combination of several UNFC sub-categories. This is illustrated in Figure 4.

30. UNFC is based on three axes (E, F and G) and allows each project to be classified according to the relevant maturity. GB/T 19492-2004 does not provide a full definition of sub-classes according to a project's maturity. However, the division of classes and categories is based on the same principles: the levels of geological uncertainty and project status (E and F Axes) are closely linked and are expressed on the horizontal axis of Figure 2. Economic evaluations are included in the vertical axis of Figure 1, and mapped to the E axis. Therefore, it is possible to establish a relationship between GB/T 19492-2004 classes and categories and UNFC classes and sub-classes (Figure 4).

31. In UNFC, four classes are used for "known accumulations": "Commercial Projects", "Potentially Commercial Projects", "Non-Commercial Projects" and "Additional Quantities in Place". Previously extracted sales production quantities are not included, while non-sales production quantities are referred to as Code 12 in Figure 5.

A. Commercial projects sub-categorization

32. The Proved Developed Reserves and Proved Undeveloped EUR in GB/T 19492-2004 map to the "Commercial projects" class in UNFC. The development projects associated with the two classes of recoverable reserves are based on the approved, or economically justified, development plans. These quantities are sub-categorized as E1.1 in UNFC.

33. Proved Developed Reserves maps directly to the UNFC sub-class "On Production" (F1.1). The Proved Undeveloped EUR, with its development plan approved, maps to the UNFC sub-class "Approved for Development" (F1.2). The "Approved for Development" project requires that the capital funds have been committed and the development project is underway.

34. Proved Undeveloped EUR for which the development feasibility study has been conducted but the development plan has not been approved corresponds to the UNFC sub-class "Justified for Development" (F1.3). The "Justified for Development" project requires that a sufficiently detailed study has been conducted and the implementation of development project demonstrates the feasibility of development. The project has been demonstrated to be technically feasible, and there must be a reasonable expectation that all necessary approvals/contracts for the project to proceed to development will be forthcoming.

35. Quantities for which extraction and sales become non-profitable on the basis of current market conditions and realistic assumptions of future market conditions, but are made viable economically through government subsidies and/or other considerations, are categorized as E1.2 in UNFC. Similarly, the Proved Developed Reserves and Proved Undeveloped EUR map to E1.2.

36. Associated quantities derived from Proved Developed Reserves, Proved Undeveloped EUR, Proved SER, Probable EUR, Probable SER, and Possible TUR that are forecast to be extracted, but will not be available for sale will be linked to Sub-category E3.1 in UNFC. The project sub-category (F axis) will be the same as for associated quantities being extracted and sold. The level of geological uncertainty is also reflected in the project uncertainty.

B. Potentially Commercial and Non-Commercial Projects Sub-categorization

37. The Proved SER, Probable EUR, Probable SER and Possible TUR in GB/T 19492-2004 correspond to the UNFC sub-class "Potentially Commercial Projects". These four classes of recoverable reserves are reasonably expected to become commercially recoverable through oil price rise or change of other economic parameters, technical advancement or

improvement of other conditions, thus they can be assigned to E1 and E2 in UNFC. They mainly involve the following three types of projects:

- Projects that contain Proved SER associated with Proved EUR by detail development feasibility study, after the completion of Reservoir Appraisal phase;
- Projects that are demonstrated by the preliminary development feasibility study to contain Probable EUR and Probable SER above the threshold of marginal economics, in latter stage of General Exploration phase;
- Projects that contain Possible TUR, after the oil and/or gas has been discovered, and where the potential for upgrading has been established and the evaluation activities for upgrading are in progress.

38. During the General Exploration phase, the Possible TUR and Probable SER in GB/T 19492-2004 may be classified as "Non-Commercial Projects" in UNFC. Those are referred to as Sub-category E3 in UNFC. In due time, the economic condition may be updated based on new information. UNFC categories will include either: reasonable prospects for economic extraction and sale in the foreseeable future (E2), economic viability cannot be determined due to insufficient information (E3.2), or it is currently considered that there are no reasonable prospects in the foreseeable future for economic extraction and sale (E3.3), on the basis of realistic assumptions of future market conditions.

39. With regard to project maturity, there are either project activities ongoing to justify development in the foreseeable future (F2.1), or project activities are on hold (F2.2), or there are no current plans to develop or acquire additional data due to limited potential (F2.3).

40. Mapping to the UNFC Categories and Sub-categories is based on the following principles:

- Development Pending projects must, as a minimum, satisfy the definitions of both F2.1 and E2. A project that meets all technical requirements but does not meet the current economic threshold (no approved Development Plan) can be referred to as F1.3. A project with unresolved technical feasibility issues is referred to as F2.1, but if there are no doubts about commercial viability, it could still satisfy the definition of E1.1.
- Development On Hold projects are similar to Development Pending projects, but their progress in commerciality is constrained by activities which may be controlled by or outside the control of the evaluator. Projects on Hold are categorized as F2.2 to reflect the chance of commerciality but taking into account the current lack of activity progress.
- Development Unclarified projects are those where there is currently an insufficient basis for concluding that there are reasonable prospects for eventual economic extraction. This is generally caused by lack of data for making an assessment, or by evaluation being at an early stage. The projects are sub-categorized as E3.2 and as F1.3, F2.1 or F2.2 based on the level of technical maturity.
- Development Not Viable projects are potentially technically feasible projects (based on existing technology or technology currently under development), but they have been assessed as being of insufficient potential to warrant any further data acquisition activities or any direct efforts for eliminating commercial contingencies at the moment. In such cases, it can be helpful to identify and record these quantities as part of a portfolio so that in the event of a major change in commercial conditions it is possible to re-evaluate their potential for commercial development. These projects are considered to have insufficient potential for possible commercial development in the foreseeable future and are therefore always referred to as the

E3.3 sub-category in UNFC. Typically, these projects will not be technically mature due to the lack of potential and can be subcategorized as F2.3. However, there can be circumstances where, for example, the project has been improved to F1.3 and the commercial circumstances changed significantly.

41. The Probable EUR and Possible TUR in GB/T 19492-2004, for which the reservoir appraisal is underway and the economics are clarified, can be mapped to E1.1F2.1, and the Probable SER associated with Probable EUR is mapped to E2F2.1 or E3F2.1. For a project that is uneconomic currently due to uncontrollable factors, such as a drop in oil and gas prices, Proved SER could be mapped to E2F1.1 if the production of the reservoir has started or to E2F1.2 if the development plan for the project has been approved or is being implemented. The Proved SER estimated is mapped to E2F1.3 if the development plan for the project has not been approved.

42. In the case where there are reasonable prospects for economic extraction and sale in the foreseeable future (E2), but project implementation is on hold, the Proved SER that is estimated from the completion of Reservoir Appraisal phase, and the Probable EUR, Probable SER and Possible TUR that are estimated during General Exploration phase are mapped to E2F2.2 "Development On Hold" in UNFC.

43. The Proved SER and Probable SER that are lower than the threshold of marginal economics, and the Possible TUR with its economics to be determined in GB/T 19492-2004, are mapped to sub-classes of the UNFC "Non-commercial Projects". In the case where the economic viability of their extraction cannot be determined due to insufficient information (sub-category E3.2), these categories of reserves should be mapped to the sub-class of "Development Unclarified". They can be mapped to one of the categories F1.3, F2.1 and F2.2 in UNFC. The Proved SER for which the reservoir appraisal is completed, and it is technically feasible is mapped to F1.3. The Probable SER and Possible TUR for which plans are available for new data acquisition are mapped to F2.1; if the appraisal is delayed, both categories are mapped to F2.2. If it is considered, based on realistic assumptions of future market conditions, that there are no reasonable prospects for economic extraction of reserves of these categories in the foreseeable future (sub-category E3.3), these categories of reserves are mapped to sub-class "Development Not Viable".

44. In the E-F matrix, E3.1 represents the non-sales production quantities and is expressed as a numeric symbol – 12. It is not defined in GB/T 19492-2004 but included in the category of EUR. This is different from UNFC (see paragraph 51 for details).

IV. Mapping of the Exploration and Development Phases in GB/T 19492-2004 to UNFC Classes

45. In GB/T 19492-2004, the classification is mainly associated with the exploration and development phases, rather than project maturities directly. To some extent, this classification in GB/T 19492-2004 is in line with the project classification in UNFC, with the mapping relationship as shown in Figure 7.

Figure 7
Mapping of Exploration and Development Phases in GB/T 19492-2004 to Classes/Sub-classes in UNFC

GB/T 19492-2004			*UNFC*	
Reserves and Resources Class and Classification of Phases/Projects			Class	Sub-class
Discovered	Measured (Developed)	Production Operation Phase / Enhanced Recovery Projects	Commercial Projects	On Production
	Measured (Undeveloped)	Development Construction Phase / Development Construction Projects		Approved for Development
		Reservoir Appraisal Phase / Appraisal Projects		Justified for Development
	Indicated	General Exploration Phase / General Exploration Projects	Potentially Commercial Projects	Development Pending or On Hold
	Inferred		Non-Commercial Projects	Development Unclarified or Not Viable
Undiscovered	Prospective		Exploration Projects	Prospect
				Lead
	Unmapped	Regional Survey Phase / Risk Exploration Projects		Play

46. Note that at the Reservoir Appraisal phase there is already a good understanding of the reservoir and the development plan has been identified. However, some details of the design have not yet been finalized, and the development plan has not yet been approved.

47. While the project maturity in UNFC determines the commerciality of Recoverable Quantities, the classification of exploration and development phases in GB/T 19492-2004 determines the classes of reserves and resources. When the exploration and development phases of projects take place, their commercial maturity evolves, and the confidence and commercial levels of the associated reserves and resources improve. In GB/T 19492-2004, the Regional Survey phase is equivalent to risked exploration projects, the General Exploration phase is linked to general exploration projects, the Reservoir Appraisal phase corresponds to reservoir appraisal projects, the Development Construction phase to development projects, and the Production Operation phase mainly to enhanced recovery projects; they have mapping relationships with the classes and sub-classes in UNFC.

48. The appraisal projects, development construction projects and enhanced recovery projects are mapped to the "Commercial Projects" in UNFC. The enhanced recovery projects include infill wells, water (steam) injection, gas injection and polymer injection, so they are mapped to the sub-class of "On Production" in UNFC. The development construction projects are equivalent to the Proved Undeveloped reserves for which the development plan has been approved and/or the production capacity is in construction, so they are mapped to the sub-class of "Approved for Development" in UNFC. The final results of reservoir appraisal projects are Measured (undeveloped) reserves which correspond to the completion of preparing the development plan. These projects are mapped to the sub-class of "Justified For Development" under the "Commercial Projects" in UNFC.

49. The general exploration projects are mapped to "Potentially Commercial Projects", "Non-Commercial Projects" and "Exploration Projects" in UNFC. The Indicated PIIP, Inferred PIIP and Prospective PIIP are derived from the general exploration projects. The

Indicated PIIP is mainly mapped to the sub-class of "Development Pending" or "Development On Hold" under "Potentially Commercial Projects" in UNFC. The Inferred PIIP is mainly mapped to the sub-class of "Development Unclarified" or "Development Not Viable" under "Non-Commercial Projects" in UNFC. The Prospective PIIP is mapped to the sub-classes of "Prospect" and "Lead" under the "Exploration Projects" in UNFC.

50. The risk exploration projects are mapped to the sub-class of "Play" under the "Exploration Projects" in UNFC. The Unmapped PIIP can be obtained from the risk exploration projects.

V. Undefined and Unclassified Quantities in GB/T 19492-2004

51. As noted above, UNFC specifies that all non-sales quantities (lease fuel, flare and losses) may be separately identified and documented in addition to sales quantities. When needed to differentiate lease fuel and flare and losses within UNFC, quantities of each non-sales type should be accounted as a different product type (see UNFC Generic Specification D) and reported separately. Non-sales quantities are not defined and classified in GB/T 19492-2004.

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Item 4(b) of the provisional agenda
The role of the Committee on Sustainable Energy and its subsidiary bodies in Supporting the 2030 Agenda on Sustainable Development: Sustainable resource management

Bridging Document between the National Standard of the People's Republic of China Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) and UNFC

Prepared by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification[1]

Summary

This document provides the Bridging Document between the National Standard of the People's Republic of China Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) and the United Nations Framework Classification for Resources (UNFC). Bridging Documents explain the relationship between UNFC and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and

[1] This Bridging Document was developed by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification. Following review by the Expert Group at its eighth session, 24-28 April 2017, the Bridging Document was issued for public comment from 15 February to 15 April 2018. Development of this Bridging Document has followed the Document Approval Procedure agreed by the Expert Group at its fifth session, April 2014. The Bridging Document is presented to the Committee on Sustainable Energy at its twenty-seventh session for endorsement.

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guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical Codes. This Bridging Document compares reserves and resources by Categories and Classes of GB/T 17766-1999 to Categories and Classes of UNFC. GB/T 17766-1999, a national standard issued in 1999, applies to mineral exploration planning and deployment, mineral resources and reserves estimation, preparation of reports of mineral resources and reserves for each stage of exploration and development of mineral resources and reserves. This Bridging Document does not affect the independent application of GB/T 17766-1999 and application of GB/T 17766-1999 does not affect any component of UNFC. In the event of any difference between the Chinese language version and any other language version, the Chinese language version shall prevail.

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I. Introduction

1. This bridging document between the Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) (hereinafter referred to as GB/T 17766-1999) and the United Nations Framework Classification for Resources (hereinafter referred to as UNFC) details the correlation between GB/T 17766-1999 and UNFC.

2. GB/T 17766-1999 is independent of UNFC. This bridging document does not affect the independent application of GB/T 17766-1999.

3. The application of GB/T 17766-1999 does not affect any component of UNFC.

II. Overview of GB/T 17766-1999

A. Brief Introduction to GB/T 17766-1999

4. GB/T 17766-1999, a national standard issued in 1999, applies to mineral exploration planning and deployment, mineral resources and reserves estimation, preparation of reports of mineral resources and reserves for each stage of exploration and development of mineral resources and reserves. It is applicable to the evaluation of mineral resources and reserves, registration, statistics, scheduling, planning, formulation of policies on mineral resources and reserves, and the development of mineral exploration rules, standards and guidelines, and can also serve as the basis for mineral rights transfers and financing for mineral exploration and development.

5. GB/T 17766-1999 classifies Identified Mineral Resources and Undiscovered Resources. Identified Mineral Resources are divided into three classes: Mineral Resources, Basic Reserves and Reserves. GB/T 17766-1999 applies a three-dimensional numerical coding scheme in which quantities are classified based on the three fundamental criteria: Degree of Economic Viability (E), Level of Feasibility Assessment (F) and Degree of Geological Assurance (G). Combinations of these criteria form a three-dimensional system. Figure 1 shows the entire classification and codification of GB/T 17766-1999.

Figure I
Classification of GB/T 17766-1999

<table>
<tr><td rowspan="2">Degree of Geological Assurance
Classification Category
Degree of Economic Viability</td><td colspan="3">Identified Mineral Resources</td><td>Undiscovered Resources</td></tr>
<tr><td>Measured</td><td>Indicated</td><td>Inferred</td><td>Reconnaissance</td></tr>
<tr><td rowspan="4">Economic</td><td>Proved Reserves (111)</td><td rowspan="4" colspan="2"></td><td rowspan="8"></td></tr>
<tr><td>Basic Reserves (111b)</td></tr>
<tr><td>Probable Reserves (121)</td><td>Probable Reserves (122)</td></tr>
<tr><td>Basic Reserves (121b)</td><td>Basic Reserves (122b)</td></tr>
<tr><td rowspan="2">Marginal Economic</td><td>Basic Reserves (2M11)</td><td rowspan="2" colspan="2"></td></tr>
<tr><td>Basic Reserves (2M21)</td><td>Basic Reserves (2M22)</td></tr>
<tr><td rowspan="2">Sub-Marginal Economic</td><td>Mineral Resources (2S11)</td><td rowspan="2" colspan="2"></td></tr>
<tr><td>Mineral Resources (2S21)</td><td>Mineral Resources (2S22)</td></tr>
<tr><td>Intrinsic Economic</td><td>Mineral Resources (331)</td><td>Mineral Resources (332)</td><td>Mineral Resources (333)</td><td>(334)?</td></tr>
<tr><td colspan="5">Notes: Codes used in Figure (111– 334)
The first digit refers to economic viability: 1 = Economic; 2M = Marginal Economic; 2S = Sub-Marginal Economic; 3 = Intrinsic Economic? = Economic-Interest Undefined.
The second digit refers to level of Feasibility Assessment: 1 = Feasibility Study; 2 = Prefeasibility Study; 3 = Scoping Study.
The third digit refers to Degrees of Geological Assurance: 1 = Measured; 2 = Indicated; 3 = Inferred; 4 = Reconnaissance; B = Reserves without deducting any design or mining losses.</td></tr>
</table>

B. Characteristics of GB/T 17766-1999

6. As a Chinese national standard, GB/T 17766-1999 together with all related technique specifications and guidelines for exploration, constitutes a complete standard system for mineral resources in China. It can ensure the orderly, high-quality exploration of mineral resources in China.

7. In the field of estimation and management of mineral resources and reserves, China has noteworthy characteristics.

8. The process of mineral exploration and development is divided into three phases: mineral exploration, mine design and construction, and mine production. Mineral exploration is divided into four stages: reconnaissance, prospecting, general exploration, and detailed exploration.

9. Application of industrial indexes is one of the noteworthy characteristics of GB/T 17766-1999. The industrial indexes proposed for the mineral quality and mining technical conditions under technical and economic conditions during a certain period shall serve as the basis for delineation of an ore body and the estimation of mineral resources and reserves. They generally comprise general industrial indexes and verified industrial indexes of a specific ore deposit. The general industrial indexes are derived from the experience accumulated by the industry in the long-term mineral exploration, technical and economic verification and mining activities. They are generally used in reconnaissance and prospecting stages. The verified industrial indexes of a specific ore deposit come from the technical and economic verification through normative procedures and upon comprehensive consideration of geological, mining, metallurgy, comprehensive utilization, economy, environmental protection, laws and regulations, society and government and other factors by technical personnel of different professions. They are generally used for the general exploration, detailed exploration stages, mine design and construction, and mine production phases. The verification of industrial indexes is essentially a process of prefeasibility study or feasibility study.

10. The content of mineral exploration in China not only includes achieving knowledge of regional geology and ore body geology through geochemical and geophysical surveys and prospecting, mapping, trenching, drilling, down-hole geophysics etc., but also comprises doing appraisal and research of hydrogeology, engineering, and environmental geology related to mining technical conditions, and doing research of mineralogy, mineral processing and finally smelting to meet mine design and mine production.

11. GB/T 17766-1999 categories correspond directly to mineral exploration and development stages and level of feasibility assessment as shown in Figure 2.

Figure 2
Correspondence between Phases of Mineral Exploration and Development, Level of Feasibility Assessment and Categories

Phases of Mineral Exploration and Development		*Target*	*Feasibility Assessment*	*Application of Industrial Indexes*	*Categories*
Mineral Exploration Phase	Reconnaissance Stage	Find an area with greater potential for mineralization	Quite simple technical and economic assessment	General industrial index	(334)?
	Prospecting Stage	Find a deposit	Scoping study	General industrial indexes	(333), (334)?
	General Exploration Stage	Make a judgment whether the project has any commercial value or not	Prefeasibility study or scoping study	Verified industrial indexes	If a deposit has a potentially commercial value, based on a scoping study, the categories are mainly (332), (333), with a few (334)?; based on a prefeasibility study, the categories are (122b), (333). If it has no commercial value, the exploration project will be finalized, with no resources registered into the national resources or reserves base
	Detailed Exploration Stage	Conduct detailed exploration to provide grounds for a feasibility study or mine design and development	Feasibility study, prefeasibility study or scoping study	Verified industrial indexes	Scoping study: (331), (332) and (333). Prefeasibility study: (121b), (122b), (333), (121), (122). Feasibility study: (111b), (122b), (333), (111), (122)
Mine Design and Construction Phase		Complete mine development and construction on schedule	Mine design	Verified industrial indexes	(111b), (122b), (333), (111), (122)
Mine Production Phase		Achieve commercial production on schedule and meet cash flow requirement and quality specification	Production plan	Verified industrial indexes	(111b), (122b), (333), (111), (122)

III. Overview of UNFC

12. UNFC was developed by experts under the auspices of the United Nations Economic Commission for Europe (UNECE) and was published by UNECE. UNFC applies to international energy and mineral research, government resource management as well as the industrial process planning and efficient capital allocation of businesses.

13. UNFC is a generic principle-based system in which quantities are classified based on the three fundamental criteria: economic and social viability (E), field project status and feasibility (F), and geological knowledge (G), using a three-dimensional numerical independent coding scheme. Combinations of these criteria form a three-dimensional system.

14. Each criterion (axis) is divided into various categories. For example, the F axis is divided into three categories: F1, F2 and F3, and each category is further divided into a number of sub-categories (for example, F1 is further divided into F1.1, F1.2 and F1.3). The specific classification is shown in Figure 3.

Figure 3
UNFC Classes and Sub-classes Defined by Categories and Sub-categories

UNFC Classes Defined by Categories and Sub-categories						
Total Commodity Initially in Place	Extracted	Sales Production				
		Non-sales Production				
	Class		Sub-class	Categories		
				E	F	G
	Known Deposit	Commercial Projects	On Production	1	1.1	1.2.3
			Approved for Development	1	1.2	1.2.3
			Justified for Development	1	1.3	1.2.3
		Potentially Commercial Projects	Development Pending	2	2.1	1.2.3
			Development On Hold	2	2.2	1.2.3
		Non-Commercial Projects	Development Unclarified	3.2	2.2	1.2.3
			Development Not Viable	3.3	2.3	1.2.3
		Additional Quantities in Place		3.3	4	1.2.3
	Potential Deposit	Exploration Projects	No sub-classes defined	3.2	3	4
		Additional Quantities in Place		3.3	4	4

IV. Alignment of Axes

A. Alignment of the G Axis

15. In GB/T 17766-1999, the G axis represents the degrees of geological assurance, representing the confidence in exploration results, and is divided into four categories: (i) Measured; (ii) Indicated; (iii) Inferred; and (iv) Reconnaissance.

16. In UNFC, the G axis represents geological knowledge and is divided into four categories.

17. The categories of the G axis of GB/T 17766-1999 and UNFC essentially correspond to each other one on one as shown in the grey area (Degree of geological assurance rows) in Figure 4.

Figure 4
Alignment of the Axes of GB/T 17766-1999 and UNFC

<table>
<tr><th colspan="2" rowspan="2">GB/T 17766-1999</th><th colspan="3">UNFC</th></tr>
<tr><th>Category</th><th>Sub-Category</th><th></th></tr>
<tr><td rowspan="7">Degree of Economic Viability</td><td>1</td><td>E1</td><td>E1.1
E1.2</td><td rowspan="7">Economic and Social Viability</td></tr>
<tr><td>2M</td><td rowspan="3">E2</td><td rowspan="3"></td></tr>
<tr><td>2S</td></tr>
<tr><td>3</td></tr>
<tr><td></td><td rowspan="3">E3</td><td>E3.1</td></tr>
<tr><td>3</td><td>E3.2</td></tr>
<tr><td></td><td>E3.3</td></tr>
<tr><td rowspan="5">Level of Feasibility Assessment</td><td>1</td><td rowspan="2">F1/F2</td><td></td><td rowspan="5">Field Project Status and Feasibility</td></tr>
<tr><td>2</td><td></td></tr>
<tr><td rowspan="2">3</td><td>F2</td><td></td></tr>
<tr><td>F3</td><td></td></tr>
<tr><td></td><td>F4</td><td></td></tr>
<tr><td rowspan="4">Degree of Geological Assurance</td><td>1</td><td>G1</td><td></td><td rowspan="4">Geological Knowledge</td></tr>
<tr><td>2</td><td>G2</td><td></td></tr>
<tr><td>3</td><td>G3</td><td></td></tr>
<tr><td>4</td><td>G4</td><td></td></tr>
</table>

B Alignment of the F Axis

18. In GB/T 17766-1999, the F axis represents the level of feasibility assessment and is divided into three categories: (i) Feasibility study, (ii) Prefeasibility study, and (iii) Scoping study. No sub-category is defined.

19. In UNFC, the F axis represents the field project status and feasibility and is divided into four categories: F1, F2, F3 and F4, in which F1 and F2 can be divided into sub-categories. The alignment of the F axis is shown in the blue area (Level of feasibility assessment rows) in Figure 4.

20. GB/T 17766-1999 emphasizes the level of the feasibility assessment, and UNFC emphasizes field project status and technical feasibility. Their categories do not directly correspond to each other. Generally, a feasibility study or prefeasibility study on the technical factors may have two results: one is that the current technical condition can meet the requirement of a mine development or production; the other is that the technical

feasibility of the project needs to be confirmed further. Therefore, both categories "1" and "2" of the F axis in GB/T 17766-1999 may correspond to F1 or F2 in UNFC.

21. A scoping study in GB/T 17766-1999, which is a preliminary assessment of the technical and economic viability for the development of mineral resources, may apply to all stages of mineral exploration activities. The conclusions of the scoping study in the prospecting stage have a relatively low degree of confidence. The conclusions of the scoping study based on general exploration and detailed exploration have a higher degree of confidence, especially with verification of industrial index. The scoping study corresponds to F2 or F3 in UNFC.

22. At the reconnaissance stage in GB/T 17766-1999, it is required that local geological studies and exploration activities, site-specific geological studies and exploration activities should be done and Undiscovered Resources may be estimated. The category of the level of the feasibility assessment at this stage in GB/T 17766-1999 is 3. In this case, the level of the technical feasibility in GB/T 17766-1999 corresponds to F3 in UNFC as shown in Figure 4.

23. F4 in UNFC is not defined in GB/T 17766-1999.

C. Alignment of the E Axis

24. In GB/T 17766-1999, the E axis represents the evaluation of the economic rationality at the time, and is divided into 4 categories: Economic, Marginal Economic (2M), Sub-Marginal Economic (2S) and Intrinsic Economic. No sub-categories are defined.

25. In UNFC, the E axis represents economic and social viability, and is divided into E1, E2 and E3 categories. E1 and E3 can be divided into sub-categories.

26. In GB/T 17766-1999, "Economic" represents the fact that the prefeasibility or feasibility study shows that extraction at the time is economically reasonable under the market conditions, or it is possible to develop with assistance from government subsidies and other forms of assistance. It corresponds to E1.1, E1.2 sub-categories in UNFC;

27. "Marginal Economic" represents the fact that the prefeasibility or feasibility study shows that extraction at the time is uneconomic, but may become economic as a result of improved conditions or through other supportive measures of governments in the future. It corresponds to E2 in UNFC.

28. "Sub-Marginal Economic" represents the fact that the prefeasibility or feasibility study shows that extraction at the time is not economic or is not technically feasible and would require substantially higher commodity prices or a major cost-reducing advance in technology before it becomes economic. Generally, it corresponds to E2 in UNFC.

29. "Intrinsic Economic" refers to the mineral resources which have been through a scoping study. It represents the fact that extraction of the mineral resources is expected to become economically viable in the foreseeable future. Category "Intrinsic Economic" corresponds to E2 in UNFC.

30. "Economic-Interest Undefined", where it is impossible to determine its degree of economic viability due to insufficient information, only corresponds to undiscovered resources achieved at the reconnaissance stage in GB/T 17766-1999. It corresponds to E3.2 in UNFC.

31. E3.1 and E3.3 in UNFC are not defined in GB/T 17766-1999.

V. Alignment of Classes and Categories

32. GB/T 17766-1999 and UNFC do not correspond to each other very well at the level of the E and F axes, but they may correspond between classes as shown in Figure 5 and Figure 6.

33. "Reserves" in GB/T 17766-1999 correspond to the "Commercial Projects" class in UNFC.

34. "Basic Reserves" with "b" in GB/T 17766-1999 generally correspond to "Reserves" plus relevant design or mining losses. For example, (111b) equals to (111) plus (design or mining losses). They are not defined in UNFC.

35. "Basic Reserves" beginning with "2M" corresponds to the "Potentially Commercial Projects" class in UNFC.

36. "Mineral Resources" beginning with 2S in GB/T 17766-1999 correspond to the "Potentially Commercial Projects" class in UNFC.

37. "Intrinsic Economic Mineral Resources" correspond to "Potentially Commercial Projects" class in UNFC.

38. "Economic-Interest Undefined Undiscovered Resources", that is (334)?, correspond to the "Exploration Projects" class in UNFC.

Figure 5
Mapping of GB/T 17766-1999 to UNFC Classes and Categories

<table>
<tr><th colspan="2">GB/T 17766-1999 Classes</th><th colspan="4">GB/T 17766-1999 Categories</th><th>UNFC Classes</th><th colspan="3">UNFC "minimum" Categories</th></tr>
<tr><td rowspan="2">Economic</td><td rowspan="2">Reserves</td><td>(111)</td><td></td><td></td><td></td><td rowspan="2">Commercial Projects</td><td rowspan="2">E1</td><td rowspan="2">F1</td><td rowspan="2">G1,G2</td></tr>
<tr><td>(121)</td><td>(122)</td><td></td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="4">Basic Reserves</td><td>(111b)</td><td></td><td></td><td></td><td colspan="4" rowspan="2">Not defined in UNFC</td></tr>
<tr><td>(121b)</td><td>(122b)</td><td></td><td></td></tr>
<tr><td>Marginal Economic</td><td>(2M11)</td><td></td><td></td><td></td><td rowspan="4">Potentially Commercial Projects</td><td rowspan="4">E2</td><td rowspan="4">F2</td><td rowspan="4">G1,G2,G3</td></tr>
<tr><td></td><td>(2M21)</td><td>(2M22)</td><td></td><td></td></tr>
<tr><td>Sub-Marginal Economic</td><td rowspan="3">Mineral Resources</td><td>(2S11)</td><td></td><td></td><td></td></tr>
<tr><td></td><td>(2S21)</td><td>(2S22)</td><td></td><td></td></tr>
<tr><td>Intrinsic Economic</td><td>(331)</td><td>(332)</td><td>(333)</td><td></td></tr>
<tr><td>Economic-Interest Undefined</td><td>Undiscovered Resources</td><td></td><td></td><td></td><td>(334)?</td><td>Exploration Projects</td><td>E3</td><td>F3</td><td>G4</td></tr>
</table>

Figure 6
Mapping of GB/T 17766-1999 to UNFC by E and F Axes

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3	F4
E1.1			3	4				
E1.2			3					
E2			4	4				
E3.1	10	10	10	10	10	10		
E3.2			6	6	6			
E3.3								8

			UNFC Sub-Classes
Economic	Reserves		On production
			Approved for Development
		3	Justified for Development
	Basic Reserves	Not defined in UNFC	
Marginal Economic	Basic Reserves	4	Development Pending
			Development On hold
Sub-marginal Economic	Mineral Resources	4	Development Pending
			Development On hold
Intrinsic Economic	Mineral Resources	4	Development Pending
			Development On hold
Not defined in GB/T 17766-1999		6	Development Unclarified
			Development Not Viable
		8	Additional Quantities in Place
Economic-Interest Undefined	Undiscovered Resources	9	Exploration Project
Not defined in GB/T 17766-1999		10	Quantities forecast to be extracted but not for sale
Less Common Mappings			